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SYMPOSIUM ON RECENT ADVANCES IN THE TREATMENT AND CONTROL OF INTERNAL PARASITES*

1.—Immune Mechanisms in Helminth Infections

BY

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A CONSIDERABLE amount of work has demonstrated that animals can become immune to helminth infections and a series of reviews has periodically given the recent advances in this subject (see Taliaferro, 1940; Culbertson, 1941; Chandler, 1953; Soulsby, 1958a, 1960a, 1961). Within the last few years some of this knowledge has been applied to practical control measures such as vaccination against *Dictyocaulus viviparus* infection in cattle (Jarrett *et al.*, 1958) and preliminary reports have been made regarding comparable techniques for the control of *Haemonchus contortus* in sheep (Jarrett *et al.*, 1959) and in cattle (Ross, Armour, Hart and Lee, 1959) and hookworms in dogs (Dow *et al.*, 1957).

Though within the near future it is likely that more use will be made of vaccines to control helminth infections, this article will deal principally with the intrinsic mechanisms which are responsible for the immunological phenomena. It is intended to deal with these in 2 categories; firstly, the phases of the parasite life cycle which are responsible for providing antigens which immunise an animal in a protective capacity, and, secondly, the mechanisms of the host which are responsible for this immunity.

It has been known for a considerable time that in order to produce good immunity it is necessary to have a living parasite within the host, and conversely non-viable parasite materials generally produce only a low degree of immunity. It is known that in antibody response is demonstrable in helminth infections and also that comparable antibodies can be produced by vaccination with non-viable material and generally such antibodies have no protective capacity. It is generally considered that such antibodies are non-protective or "non-functional" in character. The functional antibodies and the functional antigens that stimulate them are the entities with which we shall be concerned.

During recent years it has become clear that it is not necessary that all parts of the life cycle of the parasite need to be accomplished for a satisfactory immune response to develop to the infection. However, some degree of development on the part of the parasite is necessary before the essential functional antigens can be produced and given to the host. This is illustrated in the case of the use of X-irradiated larval vaccines for inducing immunity against *D. viviparus* or *H. contortus* infection. In these cases ionising irradiation will produce an inability to develop to the mature stage but will allow development to occur through various immunising larval phases. Too much ionising radiation is to be avoided since this interferes with development and probably prevents the development of larval stages which have an immunising capacity. This has been more clearly demonstrated in the case of *Trichinella spiralis* infection in experimental animals. Gould *et al.* (1957) have shown that increasing doses of irradiation on *T. spiralis* infective larvae increasingly affect the ability of these nematodes to develop and persist in an animal, and if irradiation is too marked then very little development occurs and as a consequence any immunity produced is of very low order.

Though Stoll (1958) reported that he was able to induce a high degree of immunity by giving either subcutaneous or intraperitonal injections of infective third stage larvae of *H. contortus* to sheep and cattle, Silverman and Patterson (1960) and Soulsby (unpublished) were unable to confirm this work. Silverman and Patterson (1960) further investigated the immunising power of the various larval stages of *H. contortus* and found that while third stage larvae possessed very limited immunising capacity, fourth and fifth larval stages obtained from other infected sheep possessed a satisfactory immunising ability. More extensive and elegant work by Zaiman and

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co-workers (1953a, b, c; 1954a, b) has investigated the bowel phase of *T. spiralis* infection in animals using parabiotic union. This technique is particularly valuable in that on infection of one member of the united pair with the parasite the uninfected member will become immune if the substances which stimulate immunity circulate in the blood of the infected animal. Zaiman and his colleagues were able to show that the protective antigens were blood borne and would immunise the uninfected parabiotic twin. They further showed that it was necessary for the parasite *T. spiralis* to undergo development within the infected parabiotic twin up to a period of 5 days before adequate immunity was produced, and if this time was reduced to 4, 3 or 2 days then immunity was of a low order.

In the case of experimental Ascaris infection in guinea-pigs and rabbits it has been shown that the period between the fourth and fifth day after infection is the first time at which to expect any marked production of antigen by the population of larvae in the animal (Soulsby, 1958b).

The foregoing has served to illustrate that not only must the parasite be living within the host but also it must develop to a certain stage before the functional antigens are released to induce functional immunity. Similarly, if the effect of the host on the parasite is considered it is seen also that a parasite population must develop to a certain stage before it can be affected by the immune mechanisms. Thus, despite a high level of immunity in an animal against a given parasite, it is possible to infect that animal and to have larval stages existing, maintaining themselves and even growing to some extent before the immune mechanisms can operate against them. This can be demonstrated in actual infections or can be demonstrated by *in vitro* techniques. In the case of experimental infections of *H. contortus* and *Trichostrongylus* spp. in sheep (Soulsby, unpublished) even in highly immune animals a challenge dose of larvae will enter and maintain itself for a few days before it is affected by the immune processes of the host. Similarly, in the case of Ascaris infection in various animals the challenge dose of larvae will establish itself in numbers comparable to those to be found in control animals, and only after a certain amount of development has taken place is the population affected by the immune mechanisms. This, in the case of Ascaris infection in guinea-pigs, is illustrated in Fig. 1.

Several *in vitro* tests can be applied to various larval stages to indicate the effect of antibody on the larval stages, but probably the most familiar test is that produced when various larval stages are immersed in homologous immune serum. This produces precipitates which develop around the natural orifices, namely, the mouth, the excretory pore and the anus of the larvae. These precipitates are a result of a reaction between antigen which derives from the natural orifices and the antibody in the serum (Jackson, 1960). In the case of *H. contortus* infection, although Hawkins and Cole (1945) demonstrated that the infective larvae of various sheep strongyles would develop such precipitates when placed in immune

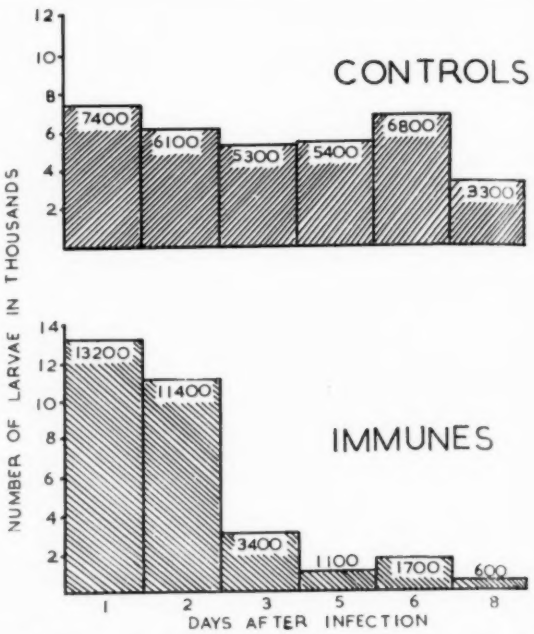

FIG. 1.—Numbers of larvae present in lungs and livers of various guinea-pigs daily after a challenge dose of 100,000 infective Ascaris eggs. The immune guinea-pigs received 3 immunising doses of infective eggs subcutaneously. This figure indicates that large numbers of larvae are able to invade an immune animal and only when they have developed for a certain time (2 days) is their number greatly decreased. Compare the marked decline in the number of larvae in the immune group with the fairly constant number in the controls.

serum, it has been impossible to confirm this work and Silverman and Patterson (1960) and Stewart (1960) have shown that third stage infective larvae will not be affected by this process, however fourth stage larvae are affected. Similarly, in the case of *Ascaris suum* infection in experimental animals Soulsby (1957a) has shown that while second stage infective larvae are not affected by the immune serum, third stage larvae are affected. In both cases this indicates that the infective larval stage does not possess or does not produce antigens which are affected by the immune mechanisms of the body, and confirms the fact that in an immune animal infective larvae can enter, persist and even grow for a short while. The sum of this evidence is that a certain degree of development is necessary before the functional antigens are available either to be given to the host to stimulate immunity or to be affected by the host's immune mechanisms.

At the present stage of our knowledge it is not known whether the antigens which are functional in this respect are present the whole time in all these larval stages and only at some period are they uncovered so as to be available to the body, or that in the early larval stages the antigens have not as yet developed and only after a certain degree of development has occurred do they become available in sub-

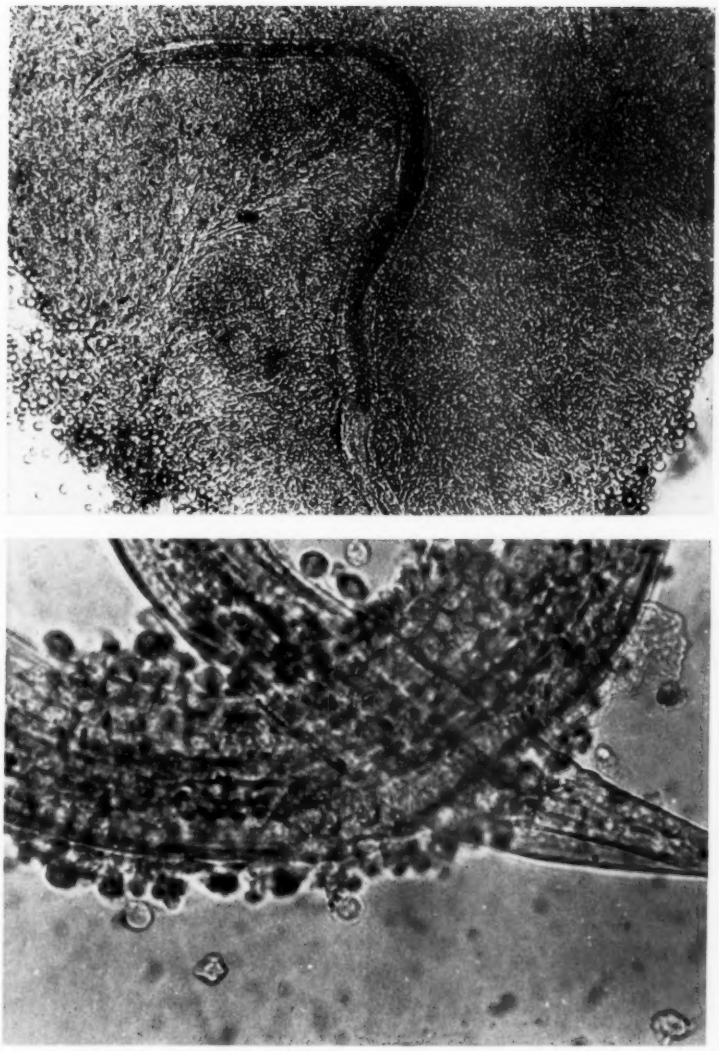

FIG. 3.—Third stage Ascaris larvae harvested from the peritoneal cavity of a rabbit, immune to Ascaris, 4 hours (below) and 24 hours (above) after being placed there. The majority of the cells are eosinophils. Normal rabbits do not produce this reaction and second stage, infective larvae are not affected in the immune rabbit.

stantial amounts. As a parasite continues its development various organs and systems within it increase in size and complexity and it is possible that some particular system needs to increase to a critical level of development before the essential antigens are produced.

Associated with the development of parasites is the necessity for them to undergo a moulting process in order that they can metamorphose to the next larval stage. Within recent years this moulting phase has been found to be of considerable importance in providing the host with functional antigens. Similarly, the moulting period has been found to be a particularly important stage to be attacked by the immune mechanisms of the host (Soulsby, 1959). In the case of the spectacular phenomenon of "self cure" in *H. contortus* infections in sheep it has been demonstrated by Soulsby and Stewart (1960) that moulting of a challenge dose of *H. contortus* infective larvae from the third to the fourth larval stage in the abomasum is responsible for the initiation of this reaction. By infecting suitably sensitised and infected sheep it was possible to demonstrate by serial killings that the challenge dose of larvae which was destined to initiate the self cure reaction in such sheep had no effect on the sheep until a moult from the third to the fourth larval stage occurred and at this time the worms which had been previously found in the abomasum were present in the small intestine and elsewhere in a state of disintegration. Serological studies of this reaction have shown that there is a marked reaction to exsheathing fluid. Exsheathing fluid (Sommerville, 1957) is produced by infective larvae when they divest themselves of the retained sheath of the second stage larvae. It is activated by a dialysable factor or factors in the alimentary tract. Though no critical tests have been performed with moulting fluid which is derived from *H. contortus* larvae moulting from the third to the fourth larval stage, sufficient evidence exists to suggest that a comparable substance is produced in order that the third stage larvae may exsheath to become fourth stage larvae and that the marked serological responses demonstrated are produced by the host in response to a substance comparable to exsheathing fluid. In the case of Ascaris infection in experimental animals it is also possible to demonstrate that the material produced when Ascaris larvae hatch (Hatching fluid —Rogers, 1958) will give a marked reaction with immune serum from an actual Ascaris infection. If studied by agar diffusion precipitation techniques, hatching fluid shows no relationship to antigens prepared from adult Ascaris worms (see Fig. 2). Work carried out on Ascaris infection in experimental animals has shown that it is the moulting period which is the most critical time for the immune mechanisms to affect the parasite population (Soulsby, 1961). Since a certain degree of development is necessary before parasites can either be affected by the immune mechanisms or can give to the host the functional antigens it may well be that the development necessary is that development which will ensure that the larvae will reach moulting phase. At this time the functional antigens may be specifically

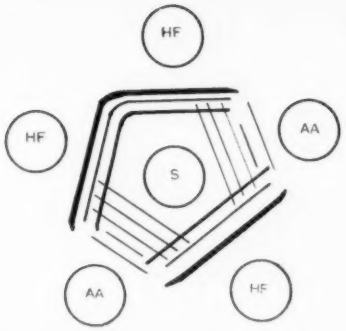

FIG. 2.—Diagrammatic representation of the precipitin lines in agar gel (Ouchterlony technique) between immune serum (S) from a rabbit infected with Ascaris eggs, hatching fluid (H.F.) of Ascaris infective larvae and an antigen (A.A.) prepared from adult Ascaris worms. Note that the hatching fluid gives a marked reaction and also that the precipitin lines are not related to those produced by the adult Ascaris antigen—thus indicating that the two antigens are different.

produced or may be uncovered. Further work is needed to discover whether the differences in the various larval stages are quantitative or qualitative.

Douvres (1960) in the United States has cultured the larval stages of the cattle nodular worm *Oesophagostomum radiatum* in media which allow their growth. He has shown that in media containing either immune serum or extracts of intestinal tissues from immune animals only larvae which have undergone some degree of development are affected by the immune elements. He describes precipitates at the natural orifices of the larvae and a "coating reaction" on the cuticle which is probably an immune adherence phenomenon. This reaction is particularly marked at the time of moulting. Larval stages in the period of moulting from the fourth to the fifth larval stages are not affected. A study of the life cycle of this parasite shows that it is only the third larval stages which live in the mucosa of the intestine of the bovine host, the later larval stages (the late fourth and fifth larval stages) occur in the lumen. The *in vitro* reactions described by Douvres are specific against the earlier larval stages. This would tend to suggest not only that it is the early larval stages present in the tissues which are responsible for the immunising of the animal but also that there is a qualitative difference between these and the later larval stages. It would be expected that if the antigens of all the larval stages were the same, then the fourth larval stages would show the same effects *in vitro* as the earlier larval stages. Some evidence that the antigens of the various larval stages do differ can be seen by vaccinating guinea-pigs with the metabolic products of Ascaris larvae. A degree of protection is produced but this protection is against the stages from which the metabolic products were obtained. Though in many cases it is only the early larval stages which are necessary for inducing immunity in nematode infections, the adult parasite can be responsible for immunity. In the case of *Trichostrongylus* spp. in sheep Stewart (1950) has shown

that the adult parasites can induce a good antibody response. Work in Cambridge on the transplantation of adult worms of *Nippostrongylus muris* has shown that transplanted worms will induce precipitating antibodies and will also immunise a rat so that a challenge infection of larvae will produce a wide variety of inhibited larval stages.

Existing knowledge on the specificity of immunity would suggest that it is specific for the individual parasite, at least on the generic level since, for example, sheep immune to *H. contortus* are fully susceptible to *Trichostrongylus* spp. and *vice versa*. However, in the case of immunity acting on oogenesis of nematodes some suggestion that this may have a cross reaction is seen in work with *Cooperia* spp. in sheep (Soulsby, unpublished). In this case sheep were immunised against various *Cooperia* spp. and were then challenged with *Trichostrongylus* spp. Though no reduction in numbers of *Trichostrongylus* spp. occurred in *Cooperia*-immunised sheep as compared with control sheep, the parasites in the immunised sheep showed a very marked retardation of reproduction and oogenesis. It can be envisaged that the antigens which are associated with stimulating immunity operating against egg production in nematodes might well be associated with protein and nucleic acid synthesis and that these might be shared in various parasites. A comparable situation pertains in the case of *Trypanosoma lewisii* and *Trypanosoma duttonii* in the rat where the antibody responsible for the inhibition of reproduction, ablastin, shows common characteristics between the 2 parasites. It has recently been shown that this antibody operates in a manner which inhibits the synthesis of protein and nucleic acid (Taliaferro & Pizzi, 1960).

Many cross reactions between helminths can be demonstrated by various serological tests and if the somatic or body antigens which produce these reactions were concerned in functional immunity then it would be expected that cross functional immunity would be produced between parasitic helminths. This is not so. The functional antigens appear to be quite specific and associated with the living parasite.

Probably the most important feature of immunity to helminths is the fact that the immune reactions against various larval stages and even against the adult worm are not irreversible. The phenomenon of inhibited development of larval stages is particularly common in helminth infections and probably holds the key to a better understanding of how these mechanisms work.

In a highly immune animal invasion of the animal will occur by the challenge dose of infective larvae, but when such larvae have reached a certain stage of development they are inhibited and eventually killed. When immunity is of a lower order death of the larvae is not a sequel and only inhibition, of a reversible kind, occurs. Inhibition of development as a result of immunity is seen in several helminth infections and in some cases it has been shown experimentally that when inhibited larval stages are transferred to a normal host, normal development will be resumed (Chandler, 1936).

In cases of naturally occurring parasitism in domestic animals inhibited larval stages may be responsible for the initiation of subsequent helminth disease. In the case of sheep in Great Britain which undergo the phenomenon of the "spring rise" every year (see Morgan *et al.* 1950, 1951) it is now generally accepted that this is the result of the reactivation of inhibited larval stages due to a fall in the immune status of the sheep during the winter and this is ascribed to the lack of stimulation of the immune mechanisms of the host (Soulsby, 1957b). Consequently, whatever the inhibitory mechanisms consist of they are not irrevocable, and similarly in order for the inhibited state to be maintained the mechanisms must operate continuously. In order to allow subsequent development to take place it is necessary to assume that the parasite is capable of continual production of the antigenic material which is being affected by the immune mechanisms or at least is capable of subsequently producing it. This, then, is not comparable to the sensitisation of a static entity but is the inhibition of some kinetic process. It is necessary to examine the mechanisms which will allow this phenomenon to occur. With the ability of the larval stage to produce antigen continuously the host aspect must be considered and it is possible, under conditions of reduced replenishment of antibody to the site where the inhibition of larval development occurs, that the continued production of antigen by the parasite will result in a solution of any precipitating complexes which have been formed by the antibody.

This rendering of antigen antibody precipitate to a soluble form may lead to dissociation of antigen from antibody and the subsequent utilisation of the antigen in the developmental process. Douvres (1960) has shown with the various effects demonstrable against Oesophagostomum larvae in culture that the immune elements of both serum and tissues need to be replenished to maintain the precipitates at the natural orifices of larvae. Another important aspect which should be considered in this respect is the avidity of the antibody at particular times. It could be expected that during the early phases of immunisation avidity would be of a low order, but at the height of immunisation and particularly during a secondary response the avidity would be high. If at the time of a falling immune status in an animal antibody is less avid than usual, then dissociation of an antigen-antibody complex would be much more easy.

As early as 1932 Ross stressed that immunity to helminths is of a transient nature and in the absence of re-infection any substantial degree of protection will quickly wane. In some cases, for example, *H. contortus* immunity is of short duration and in individual sheep may be almost undetectable. Barr (1951) has stressed the necessity for proper preparation of an animal (in this case the horse) for the production of strongly avid antibodies. She suggests that the forcing of the antibody-producing mechanism before it is fully equipped results in the formation of non-avid antibody. Gibson (1952) has shown that small doses of *Trichostrongylus axei* given to lambs one month old increased their resistance but large doses decreased resistance and these observations

could be ascribed to the phenomenon described by Barr, that is non-avid and hence non-functional antibody being produced under conditions of marked antigenic stimulation in the young animal.

During the several years that immunity to helminths has been studied it has been generally assumed that antibodies are the main mediators of the immune mechanism and furthermore that such antibodies would probably function in a precipitating capacity. This assumption has grown due to the fact that precipitates can be demonstrated at the natural orifices of helminths when they are placed in immune serum. Originally it was envisaged that such precipitates blocked the orifices and interfered with feeding and excretion (Culbertson, 1941). Taliaferro (1958) has commented upon this and remarks that perhaps too much emphasis has been placed on precipitating antibodies and that other antibodies such as non-precipitating and skin sensitising antibodies may be of importance. It is a familiar fact that in helminth infections skin sensitising antibodies are prominent and are used in many infections as diagnostic tests. Such non-precipitating antibodies have been detected in *H. contortus* infection by Soulsby (1960b) but at present no evidence exists to show that there is a relationship between the level of these which can be determined and the resistance of the sheep.

In fact as yet no direct evidence exists to show that antibodies detected by various serological tests are concerned in immunity to helminths.

Several attempts have been made passively to immunise animals with immune serum, and some evidence of circulating antibody playing a part in immunity has been shown in the case of *N. muris* (Sarles and Taliaferro, 1936) and *Strongyloides ratti* (Lawler, 1940). However, with the exception of such work with *D. viviparus* infection (Jarrett *et al.*, 1955) the protection induced was far from comparable to that induced by an actual infection. Furthermore, in the case of *D. viviparus* large quantities (equivalent of 4.5 litres) of serum were given. Certainly it can be said that *circulating* antibody is not the main mediator of the immune response in helminth infection. Consequently, it may be necessary to consider more closely the relationship of the white blood cells of the body to immunity to helminths.

Though Silverman and Patterson (1960) have reported that the inhibition of the larval stages of *H. contortus* appears to be mediated through humoral agencies and the white cells appear to play no part in this process, studies on other parasites such as *N. muris* and *T. spiralis* by Coker (1955) and Weinstein (1955) respectively have shown that by the use of cortisone it is possible to inhibit and delay the immune response to these infections. The presence of white cells in the region of an immunological reaction against nematodes is always quite striking and the eosinophil has always been considered to be particularly associated with helminth infection. Recent work carried out in Cambridge has shown that the eosinophil possibly plays an extremely important part in immunity to helminth infections. The attraction of eosinophils to larvae of Ascaris once they have developed to a certain stage is very marked and very rapid. If third stage Ascaris larvae, that is larvae that have developed through from the infective stage, are placed in the peritoneal cavity of an immune rabbit, within a period of a few hours there is a very rapid and distinctive attack by eosinophils (see Fig. 3.). As far as can be ascertained at present this is mediated by an immunological mechanism since in normal rabbits this reaction does not occur. The infective second stage larvae are not affected, further indicating that some development is necessary before the reaction can occur. The function of the eosinophil in the body is not by any means clear, however, and the work of Spiers (1957) suggested that the eosinophil is intimately concerned in antibody formation since the injection of antigen into an animal results in an early accumulation of the eosinophils at the site. Spiers considers that the eosinophils become sensitised to the antigen and these cells are then phagocytosed by cells of the endothelial system and these in their turn produce antibody.

If Spiers's postulates are considered from the point of view of immunity to helminths they would provide a satisfactory explanation as to how antibody-producing cells are induced to the site where the immunological reaction is needed. Thus a sequence of events as follows could be envisaged. Invading larvae attract eosinophils, either to the local milieu or actually to the surface of the cuticle; these eosinophils become sensitised to the antigens of the parasite and are then phagocytosed by cells of the reticulo endothelial system which produce antibody at the local site. This to some extent stipulates a degree of local immunity, at least in the initial phases but later antibody becomes generalised.

It has generally been considered that the cuticle of a nematode is non-antigenic and non-permeable to high molecular weight substances such as antibodies and antigens (Taliaferro & Sarles, 1939; Taliaferro, 1940). However, recent work has shown that the cuticle of various nematodes is antigenic and also that antibody can become fixed to the surface of the cuticle. This has been demonstrated using a mixed agglutination technique (Coombs & Soulsby, unpublished) and an adhesion technique (Soulsby, unpublished) which also demonstrates that complement is fixed to the cuticle. Such observations would tend to strengthen the hypothesis that the eosinophil is attracted to the site of fixation of antigen and antibody. One further effect of this marked attack by white cells on larvae is that the cuticle of the nematode is rendered more permeable than it was previously. This permeability at present has been ascertained using low molecular weight materials such as eosin and methylene blue, and it has yet to be determined whether the cuticle is rendered more permeable to larger molecular weight substances such as antibodies. Consequently, as work progresses it may well be shown that the routes of the immune mechanisms of the host into the parasite are not as were previously thought. These were considered to be through the mouth, the excretory pore and the anus, but the cuticle must now be added as a possible route of entry. Since the moulting period is an important time

when the parasite population is adversely affected by the immune mechanism it is possible that the cuticle is more permeable at the moulting period and in this respect rather like the insect cuticle.

Despite the extensive work which has been carried out in various laboratories throughout the world on practical and fundamental problems of immunity to helminths there is still very little information as to the character of the functional antigens. Chandler (1953) expressed the opinion that immunity to helminths was anti-enzyme in character and it is probable that this is so. However, extremely little is known about this. Some evidence does exist to show that immunity may function in an anti-enzyme character, for example Thorson (1956) working with the dog hookworm has shown that extracts of the oesophageal glands will induce a significant degree of immunity and that immune serum from previously infected dogs possessed the ability to inhibit the enzymic activity of extracts of these oesophageal glands. Similarly, Schwabe (1957) was able to demonstrate an inhibition in oxygen uptake in *N. muris* larvae when they were placed in immune serum, and possibly in this case the antibody was acting against the enzymes responsible for oxygen utilisation. It would be envisaged, since immunity is directed against the growth and development of nematode larvae, that the antigens responsible for the stimulation of this immunity are associated with this process, and it is not unlikely that they will in the future be found to be associated with protein synthesis and nucleic acid synthesis.

The result of this fundamental work on immunity to helminths has given a better knowledge of the functional antigens which are necessary to induce immunity. Furthermore, in the production of vaccine it is unnecessary to aim at full development of the parasite; only a certain degree of development which appears to include at least one moulting phase is necessary. It is probable that within a short time vaccines will be available which will be essentially non-viable in character but derive from parasitic stages which have been grown in *in vitro* culture to a certain stage of development. In this case all that will be necessary for the production of an efficient vaccine will be to ensure that the larval stages have, in fact, reached the stage where the functional antigens are given to the medium.

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MR. ROBERT BOUTFLOUR

As we go to press we learn with regret of the death of Mr. Robert Boutflour, formerly Professor of Agriculture in the University of Bristol, and a valued friend of many members of the profession. The following note is quoted from *The Times*:—

"Mr. Robert Boutflour, C.B.E., Principal of the Royal Agricultural College, Cirencester, from 1931 to 1939 and from 1945 to 1958, died yesterday at the age of 71.

"The son of Robert Boutflour, he was born on March 9th, 1890, and educated at Barnard Castle School. He had a lively career making his mark first as Chief Agricultural Officer of Wiltshire County Council in the 1920s.

"He was Professor of Agriculture in the University of Bristol from 1935 to 1940, executive officer for Gloucestershire War Agricultural Committee from 1939 to 1945, and in the latter year resumed his duties at Cirencester. In 1955 he was Sir Thomas Baxter Gold Medallist. Three years earlier he had been created C.B.E.

"His marriage to Mary Louisa Katherine, daughter of William Somerville-Woodiwis, took place in 1914. They had two sons and one daughter."

2.—Recent Advances in the Anthelmintic Treatment of Domestic Animals

BY

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SUMMARY.—In his paper an attempt has been made to summarise some of the recent developments in the chemotherapy of helminth infestations. The effect of particle size and purity on the action of phenothiazine has been discussed with special reference to parasitic gastro-enteritis in sheep. The rôle of the organo-phosphorus compounds in the treatment of parasitic gastro-enteritis has been considered and only in cattle does the use of Neguvon seem to be worthwhile. The new anthelmintic methyridine seems likely, however, to become the anthelmintic of choice in cattle and may also rival phenothiazine in sheep. The bephenium compounds are the anthelmintics of choice in nematodiriasis in sheep.

The history and recent work on the parenteral use of carbon tetrachloride for fascioliasis in cattle and sheep has been discussed. Used by this method the drug appears to be safe but causes pain at the site of injection and in many instances local muscle necrosis follows. The compounds hexachlorophene, hetol and Freon 112 have recently been introduced as fasciolicides and some are being issued commercially. All are efficient but only hexachlorophene appears to be active against immature flukes.

The drugs cyanacethydrazide and diethylcarbamazine are both used in the treatment of lungworm infestation, particularly in cattle and sheep. Cyanacethydrazide is active against the adult worms and diethylcarbamazine against the larval forms, but neither of the drugs used alone is ideal for the treatment of parasitic bronchitis. Mention is also made of the use of ascaridol aerosols in the treatment of parasitic bronchitis.

The use of tin arsenate as an additional taeniacide for sheep is described.

In pigs the use of piperazine and the antibiotic hygromycin B as ascaricides and also against Oesophagostomum is described. The efficiency of the former is firmly established but more work under British conditions is necessary before the value of hygromycin can be finally assessed.

The piperazine compounds are excellent ascaricides in horses and are also as efficient as phenothiazine against strongyloid worms. A mixture of phenothiazine and piperazine has been shown to be the most efficient anthelmintic for use in horses.

In poultry the piperazine compounds, which can be given in the food and water, are highly efficient against Ascaridia galli. *Work from abroad indicates that hygromycin B will control both* A. galli *and* Heterakis gallinae *in poultry but the antibiotic has not been used under British conditions.*

The piperazine compounds are efficient for the removal of the ascaridoid worms of the dog and cat. Bephenium compounds are excellent for the treatment of hookworm infections in the dog and the latest addition to the series causes less vomition than those formerly used.

IN 1928 Chopra and Chandler published a book on anthelmintics and their use in medical and veterinary practice describing a large number of medicaments the majority of which were natural products. Of the anthelmintics they mentioned only 2 or 3 are still in regular use, most of them having been replaced by synthetic products superior in action and less variable in quality. Over the last 20 years the development of new anthelmintics has proceeded with increasing rapidity until nowadays scarcely a week passes without the discovery of some new compound of potential anthelmintic value. The rapidity of present day progress is illustrated by the fact that although I reviewed the treatment of gastro-intestinal parasitism in sheep and cattle at the B.V.A. Congress 2 years ago there are further striking developments which require to be brought to your notice today. In this paper I propose to consider the major parasitic diseases of the domestic animals in turn and to review the advances which have been made in their treatment during the last 5 or 6 years.

Parasitic gastro-enteritis of cattle and sheep

Some 10 or 12 species of trichostrongylid nematode are commonly involved in the causation of parasitic gastro-enteritis in ruminants, which is, therefore, really a complex of diseases requiring an anthelmintic with a wide range of activity for its efficient treatment. Phenothiazine, introduced some 20 years ago, has much to recommend it but also possesses a number of disadvantages. Perhaps the most important of these is its lack of action against immature worms; other disadvantages are the large bulk of the dose and the red staining of the fleece by metabolic products excreted in the urine or following spilling during dosing. In sheep these disadvantages may largely be overcome by the use of an automatic drenching gun incorporating the principle of the McMaster oesophageal tube (Whitlock, 1951 and 1954). Whilst phenothiazine is practically non-toxic in sheep toxicity occurs relatively frequently in cattle and Whitten, Clare and Filmer (1946) have also reported the occurrence of a photosensitisation following the administration of a therapeutic dose. It is understandable, therefore, that particular efforts have been made to find a substitute for phenothiazine for use in cattle, but before considering them it is

necessary to mention attempts which have been made to improve the action of phenothiazine itself.

Small particle size phenothiazine. As early as 1940, Gordon investigated the influence of particle size on the anthelmintic efficiency of phenothiazine and demonstrated that coarse phenothiazine was less efficient in the removal of *Oesophagostomum columbianum* than the ordinary commercial preparations. Gibson (1951), testing 6 different commercial samples of varying particle size against *Trichostrongylus axei*, could detect no difference in activity but the difference in particle size between the samples was not very great. Gordon (1956) reported extensive studies which clearly demonstrated that particle size has an influence on the anthelmintic efficiency of phenothiazine, especially on the trichostrongyles (*Ostertagia* spp. *Trichostrongylus* spp. and *Haemonchus contortus*). He was unable to make any final recommendation concerning the optimum particle size but concluded that preparations should not contain particles greater than 30 μ in diameter and that it was preferable that the majority should be less than 20 μ. Whitten (1956), Douglas *et al* (1956), Thomas and Elliott (1957) and Kingsbury (1958) have all confirmed the influence of particle size on anthelmintic efficiency, and the work of these workers shows that for full efficiency against *Trichostrongylus* spp. the majority of the particles should be below 10 μ. Thomas and Elliott (1957) suggested that the ideal phenothiazine preparation was one having 70 per cent. of the particles under 5 μ or 90 per cent. under 10 μ with the rest of the particles up to 30 μ. Gordon (1958), however, points out that in all instances extreme fineness does not give maximum efficiency, for a preparation having 50 per cent. of the particles under 2 μ gave the lowest efficiency yet recorded with phenothiazine against oxyurids in mice. Douglas, Baker and Longhurst (1959) demonstrated a linear relationship between the specific surface area of phenothiazine preparations and anthelmintic efficiency within the range of 5,000 to 25,000 sq. cm. per gramme, which represents a range of 1 to 10 μ mean particle diameter and 93 to 63 per cent. anthelmintic efficiency. They also demonstrated the effect of purity on anthelmintic efficiency and, in a further study, Baker *et al.* (1959) confirmed the influence of purity in increasing anthelmintic efficiency and defined a suitable phenothiazine preparation for sheep as having a specific surface area of 6,000 to 7,000 sq. cm. per gramme (mean particle diameter 6 μ) if pure, or of 25,000 sq. cm. per gramme (mean particle diameter 2 μ) if of American Nation Formulary standard of purity. Forsyth (1959) in a preliminary communication stressed the influence of both purity and particle size of phenothiazine on anthelmintic efficiency and in a further paper Forsyth *et al.* (1961) showed that if purity falls below 85 per cent. efficiency falls greatly. The influence of particle size was also confirmed and it was considered that this is best expressed as "dose area"—a product of dose in grammes and fineness measured by specific surface area in sq. cm. per gramme. Higher dose areas gave higher efficiency than lower ones, but in general it was immaterial whether this was achieved by a high dose of coarse particles or a lower dose of fine particles. At a given dose weight finely ground material was superior to coarsely ground samples. Fine grinding, giving greater dose area, was beneficial against *Ostertagia* spp. and *Trichostrongylus* spp. but against *Chabertia ovina* no advantage was obtained. Forsyth *et al.* calculated that for 90 per cent. efficiency against the 4 parasites of sheep, *Ostertagia* spp., *T. axei*, *Trichostrongylus* spp. in the small intestine and *Chabertia ovina*, phenothiazine of 85 per cent. purity should have a "dose area" of 185,000 sq. cm. and if of 90 per cent. purity a dose area of 155,000 sq. cm. From the practical point of view this recent work indicates that phenothiazine for use as an anthelmintic in sheep must be of at least 85 per cent. purity and that fine grinding will, in general, increase anthelmintic efficiency, the dose rate being related to the fineness to which the preparation is ground. In cattle finely ground phenothiazine is likely to increase the hazard of toxicity and no experimental work has yet been published on that subject.

New Compounds. The deficiencies of phenothiazine, especially as an anthelmintic for cattle, have prompted the search for other chemotherapeutic compounds. Riek and Keith in Australia have tested toluene, 1:8 Dihydroxyanthraquinone and certain piperazine compounds as anthelmintics in cattle and Gordon has tested a similar range of substances in sheep. Although toluene, Riek and Keith (1957a), and 1:8 Dihydroxyanthroquinone, Riek and Keith (1957b), showed some promise as anthelmintics in calves these compounds have not been brought into general use, and the piperazine compounds were found to be without useful anthelmintic action in cattle or sheep. Following their use as systemic insecticides some of the organo-phosphorus compounds have been tested for anthelmintic action in sheep and cattle. In sheep the most widely tested compounds have been O, O-dimethyl 1,hydroxy-2-trichloromethyl phosphonate (Neguvon, Dipertex, Bayer L13/59), 3-chloro-4-methyl umbelliferone-O, O-diethyl thiophosphate (Co-ral, Asuntol Bayer 21/199), O, O-dimethyl O-(2, 4, 5-trichlorophenyl) phosphorothiate (Dow E.T-57, Trolene, Etrolene) and 4-tert-butyl-2-chlorophenyl methyl methylphosphoramidate (Ruelene). Of these compounds only Bayer 21/199 had anthelmintic action superior to phenothiazine but this compound has a narrow therapeutic index and is considered to be too toxic for general use. Tests have also been carried out with these substances in cattle, in which the need for a compound active against *Ostertagia ostertagi* and *Cooperia oncophora* is particularly acute, and Neguvon has been shown to have useful action against these parasites. Banks and Michel (1960) carried out a small controlled trial with Neguvon against *O. ostertagi* in calves using dose rates of 66 and 110 mg. per kg. Efficiency was low against the larval forms but 98 per cent. of the mature worms were removed. Banks and Mitton (1960) used Neguvon in the field in the treatment of acute ostertagiasis with dramatic results; the dose rate employed being 80 mg. per kg. Earlier Riek and Keith (1958) had tested the drug on 200 calves under field conditions and found a dose rate of 44 mg.

per kg. to be highly efficient against *Haemonchus placei* and *Oesophagostomum radiatum*. At 110 mg. per kg. high efficiency was obtained against *Bunostomum phlebotomum*, *Cooperia* spp. and *T. axei*. At this dose level activity was also claimed against the immature forms of *O. radiatum*, *Bunostomum-phlebotomum* and *Cooperia* spp. Riek and Keith (1958) used dose rates of up to 2175 mg. per kg. in observations on toxicity but little correlation was seen between dose rates and the severity of symptoms. Some evidence of toxicity—increased respiration, salivation, restlessness and some looseness of the bowel—was seen at a dose rate of 110 mg. per kg. but these symptoms were temporary and passed off in 1 or 2 hours. Of more than 200 infected calves only one given 220 mg. per kg. died. Michel and Banks (1960), however, reported severe reactions following doses of 110 mg. per kg. with death occurring within 30 minutes of dosing. Banks and Mitton (1960) reported that alarming symptoms of poisoning were common in the animals they treated but that spontaneous recovery was the rule. Atropine is an effective antidote but does not prevent symptoms if it is injected before they appear. Although there is a distinct toxic hazard in the use of Neguvon its action against certain parasites of cattle is sufficient to warrant its use in the field in the absence of a superior compound.

The possibility of using the organo-phosphorus compounds as synergists with phenothiazine has been suggested by Kingsbury (1961). In a preliminary communication he has shown that a mixture of coroxon and phenothiazine giving dose rates of 2 mg. per kg. and 200 mg. per kg. was 99 per cent. efficient against *Ostertagia* spp. and *Trichostrongylus* spp. and 95 per cent. efficient against *Strongyloides papillosus* in sheep. The mixture was superior in its action to 2 mg. per kg. of coroxon alone or 500 mg. per kg. of phenothiazine alone.

Methyridine. Walley (1961) has described the use of methyridine, 2-(β-methoxyethyl) pyridine, as an anthelmintic in cattle and sheep. This substance is active as an anthelmintic whether given orally or by subcutaneous injection and the optimum dose is 200 mg. per kg. Some 491 sheep and 435 cattle were used in Walley's trials which demonstrated very high efficiency against *Ostertagia* spp., *Trichostrongylus* spp., *Cooperia* spp. and *Nematodirus* spp. in the small intestine and against *Trichuris* spp. in the caecum. Useful activity was also obtained against worms inhabiting the abomasum. *Trichostrongylus* spp. are almost completely eliminated, *Ostertagia* spp. are eliminated and many animals are cleared of *Haemonchus* spp. Activity against this latter nematode is, however, erratic and in some animals the worm burden is quite unaffected. Good action is claimed against immature worms. Toxic symptoms are unusual but a local reaction may follow subcutaneous injection of large doses in cattle. Groves (1961) summarised the results of field trials involving over 2,500 cattle and sheep and toxicity tests on a further 1,630 animals. Anthelmintic efficiency was good and in most cases rapid clinical response followed treatment. The therapeutic dose of 200 mg. per kg. was well tolerated by both cattle and sheep but one third of 50 ewes and 100 lambs given double the therapeutic dose showed inco-ordination 30 to 60 minutes later. Seven of the poorer animals went down and within 4 hours 4 of these were dead. The rest of the flock had recovered normal locomotion and the 3 sick ewes were better the following day. Six animals showed slight lameness for 4 days caused by local reactions at the injection site. In cattle local reactions were more common than in sheep. Doses of up to 60 ml. were given at a single site and resulted in oedema but no abscess formation or ulceration occurred. Further evidence of the efficiency of methyridine when used under conditions of general practice has been provided by Hamilton (1961), Gracey and Kerr (1961), Young (1961) and Macrae (1961). These preliminary results indicate that methyridine will prove effective in the treatment of gastro-intestinal parasitism in cattle. It is useful in sheep in cases of intestinal trichostrongylosis, but it is too early to say whether it will completely replace phenothiazine for routine use in sheep.

Bephenium compounds. The treatment of nematodiriasis in sheep proved to be an intractable problem until the discovery of the anthelmintic properties of the bephenium compounds. Bephenium embonate at a dose rate of 250 mg. per kg. is extremely active against the adult and larval forms of *Nematodirus filicollis*, Rawes and Scarnell (1958) and of *N. battus* Gibson (1959). Marquardt *et al.* (1960) showed that at 250 mg. per kg. bephenium embonate was 100 per cent. effective against *N. spathiger* in sheep. Bephenium hydroxynaphthoate given at a dose rate of 250 mg. per kg. is also extremely efficient against all stages of *Nematodirus* spp. (Rawes & Scarnell, 1959; Gibson, 1959). The bephenium compounds are clearly the treatment of choice for nematodiriasis in sheep. Against other trichostrongylid worms it is generally agreed that bephenium embonate is not sufficiently effective to be of use in the field (Dunsmore, 1960, and Galvin *et al.*, 1960), but bephenium hydroxynaphthoate is of some value. Rawes and Scarnell (1959) claimed high efficiency against *Haemonchus contortus*, *Ostertagia* spp., *T. axei* and *Cooperia curticei*. Dunsmore (1960) showed it to be highly effective against all stages of *Ostertagia* spp. and also against adult *T. axei* whilst Gibson (1960) reported 74 per cent. efficiency against adult *T. axei*. Banks and Korthals (1960), however, found it inferior to purified fine particle phenothiazine against *Ostertagia* and *Trichostrongylus* spp. in sheep.

In cattle Rubin (1960) found doses of 250 mg. per kg. of bephenium hydroxynaphthoate to be highly effective against *N. helvetianus*. Amour and Hart (1960) carried out critical tests on six cattle and high activity was obtained against *Haemonchus* spp., *Cooperia* spp., *O. radiatum* and *B. phlebotomum* with a dose rate of 225 mg. per kg. and these results were confirmed in field trials. Later Amour *et al.* (1961) showed that bephenium hydroxynaphthoate at a dose rate of 225 mg. per kg. was very effective against the fifth larval stages of *Haemonchus* spp. and *O. radiatum* and the fourth and fifth stages of *Cooperia* spp. Some anthelmintic action was observed

against the fifth larval stage of *T. axei* and the fourth larval stage of *O. radiatum*. The action against the fourth larval stages of *Haemonchus* spp. and *T. axei* was poor. The poor action against the fourth larval stages necessitates repetition of treatment 2 weeks after the initial dose in order to remove those larval stages which resumed their development after treatment.

Fascioliasis

Carbon tetrachloride. Carbon tetrachloride has been established as a fasciolicide in sheep since it was first introduced by Ernst (1925) in Germany and by Montgomerie (1926a) in this country. It was also used by Montgomerie (1926b) in cattle but in this species it has in many countries been largely replaced by hexachloroethane. In recent years there has, however, been a revival of interest in the parenteral use of carbon tetrachloride in the treatment of fascioliasis so some consideration must be given to that here.

In sheep the parenteral administration of carbon tetrachloride was investigated as long ago as 1927 by Nöller and Schmidt who reported using 1: 1 mixture of carbon tetrachloride and liquid paraffin by subcutaneous injection with good results and without any untoward reaction. They also reported intraperitoneal administration to be effective. The parenteral use of carbon tetrachloride must have continued in some European countries for Obitz and Wadowski (1939) refer to the use of Nöller and Schmidt's method in 3,000 sheep; 1,600 of which were reported to be cured with only 5 accidents. In more recent years there are many reports, particularly from Russia and the Eastern European countries, of the parenteral use of carbon tetrachloride. Kagramanov (1955) used carbon tetrachloride by the subcutaneous route in 1,728 sheep and claimed 100 per cent. efficiency. After-effects lasting ½ to 1½ hours consisting of rapid movements, accelerated respiration and heart beat were reported in some sheep but no deaths occurred. Yakovlev (1955) reported lameness lasting 2 to 5 minutes in a few sheep receiving carbon tetrachloride subcutaneously. Winterhalter and Delak (1955) described degenerative changes of the liver following the subcutaneous injection of a 3: 1 mixture of liquid paraffin and carbon tetrachloride. Regeneration began on the fourth day. Pregnant sheep were treated without mishap and at *post-mortem* examination 3 or 4 days after treatment only dead flukes were found in the liver. Oedema appeared at the injection site during the first 3 days and the odour of carbon tetrachloride could be detected at the site of injection. Vitenko (1956) used the drug intramuscularly as well as subcutaneously. It was given mixed with vaseline or fish fat, the former being better. Garrilyak (1956) also used the drug in vaseline and fish fat as a 1: 1 mixture and obtained good results; no toxic effects were noted. Boray (1956 a and b) used carbon tetrachloride extensively by intramuscular injection with favourable results using a dose rate in one observation of 1 ml. per 10 kg. of bodyweight, and in the other 2 ml. per 30 kg. of bodyweight. Egyed and Nemeseri (1957) used various methods of parenteral administration of carbon tetrachloride. Following subcutaneous injection of 2 to 3 ml. of the pure drug marked excitement resulted from irritation at the site of injection. Stupor and dizziness were seen later in a number of animals but these ill effects passed off in 1 to 2 hours. Following the intramuscular injection of 2 to 3 ml. of the pure drug a marked limp was seen immediately after injection which passed off in one or two hours. Six to eight ml. of a 1:1 mixture of carbon tetrachloride and paraffin oil were injected subcutaneously and caused symptoms of irritation and unrest similar to, but less spectacular than, with the pure drug. The paraffin oil injected alone produced no reaction. The intramuscular injection of the 1: 1 mixture produced a slight limp and frequent raising of the fore limbs for about half an hour. They favoured the intramuscular use of the drug mixed 1: 1 with paraffin oil for routine use and reported 90 per cent. efficiency. Delak and Marzan (1959) reported high anthelmintic efficiency from the use of pure carbon tetrachloride as a 3: 1 mixture with paraffin oil but local muscle necrosis was seen at the site of injection. No permanent lameness resulted because the lesions were restricted in area. Edwards (1959) used carbon tetrachloride mixed with equal parts of a petrolatum for intramuscular injection. Doses of 6 ml. were reported to be effective in controlling flukes and to produce no reaction or residue at the site of injection.

In cattle carbon tetrachloride was used parenterally as early as 1927, Zunker, Bach and Jordan using a preparation "T53 Merk," which contained carbon tetrachloride, by subcutaneous and intraperitoneal injection. Since then up to the present time various authors have described its use and the results are similar to those reported above in detail for sheep. Restlessness following injection and muscle necrosis or sterile abscesses at the injection site being recorded by many workers but there is also general agreement as to its efficacy. Cieleszky and Kovacs (1958) have investigated the excretion of carbon tetrachloride in the milk of dairy cows following the injection of 40 ml. of a mixture of equal volumes of carbon tetrachloride and liquid paraffin containing 1 per cent. procaine base. A significant drop in milk yield was seen on the first day followed by recovery. 1.56 to 0.09 mg. of carbon tetrachloride per litre was found in the milk and a taint was observed for 3 days. On the eighth day traces of carbon tetrachloride could be detected in one or two cows. In the butter fat, the amount of carbon tetrachloride per kg. was 3.83 mg. on the first day, 2.33 mg. on the second and 1.37 on the third. These amounts are considered to be so small that no danger would arise from the use of the milk of treated cows if it were suitably diluted by incorporation in bulk supplies. Kovacs (1959) reports on the use of a mixture of equal volumes of carbon tetrachloride and liquid paraffin with 0.5 per cent. lignocaine base intramuscularly in cattle given in doses of 40 ml. injected into 2 or 3 places in the neck. Animals slaughtered after treatment showed that 90 per cent. of the adult flukes were removed. Kovacs further reports that 150,000 cattle were treated with losses of 0.02 to 0.03 per cent.

Although the parenteral use of carbon tetrachloride is effective it does cause a proportion of severe local

reactions, and there seems little advantage in its use over the oral dose of a mixture of carbon tetrachloride and liquid paraffin which can be rapidly administered to sheep by means of an automatic dosing gun.

Hexachlorophene. Dorsman (1959) found that the subcutaneous injection of this drug in olive oil at the dose rate of 10 mg. per kg., or its oral administration at the same dose rate, was highly effective against *Fasciola hepatica.* A swelling which appeared at the site of injection disappeared slowly, but there was no adverse effect on appetite in any of the treated animals. Federmann (1959) also reported good results in 35 cattle given 10 to 20 mg. per kg. orally. Osinga (1960), however, injected the drug as a 10 per cent. solution in olive oil at a dose rate of 10 to 15 mg. per kg., and administered it orally in propylene glycol at a dose rate of 10 to 12.5 mg. per kg., but did not find it superior to hexachloroethone. He reported that painful swellings persist for some months after subcutaneous injection, and indigestion, diarrhoea, depressed milk yield and even death follow oral treatment.

In sheep Federmann (1959) gave doses of 10 to 20 mg. per kg. orally to 911 sheep and subcutaneously to 100. Faecal examinations carried out 6 weeks after treatment revealed 89 per cent. of cures in the orally treated group and 76.6 per cent. in the parenterally treated group. A local inflammation appeared at the site of inoculation but other toxic effects were not seen. Osinga (1960) found oral treatment to be effective but considered further investigation of the side effects desirable before the drug was recommended for general use.

Hetol (1, 4-bis-trichlormethyl-benzol). Following preliminary tests on white rats and rabbits Lämmler (1960) used hetol in cattle and showed that doses of 125 mg. per kg. or more were successful in reducing the count of *Fasciola* eggs in the faeces for 28 days after dosing. Enigk and Düwel (1960) used the drug on 864 naturally infected cattle at a dose rate of 160 mg. per kg. In 29 animals treated between September and November, 13 still carried flukes at *post-mortem* examinations, whilst in 20 others treated between January and March only 2 harboured flukes after treatment. The superior action of the drug in the spring was explained by the lack of action of hetol against immature flukes. Both lots of workers found the drug to be well tolerated even by sick and pregnant animals and no effect was observed in the milk yield or flavour of the milk. Lämmler (1960) found the drug satisfactory in sheep in laboratory experiments and obtained good results using a dose rate of 150 mg. per kg. in 880 sheep in the field. His laboratory experiments showed the therapeutic index to be 10 so there is a wide safety margin. Behrens (1960) also used the drug in the treatment of 3383 sheep in the field giving 5 grammes to lambs 5 to 6 months old and 10 grammes to older sheep with satisfactory results.

Difluorotetrachlorethane—Freon 112. Demidov (1955) gave doses of 0.3 to 0.6 ml. per kg. to sheep and concluded that the drug was effective and suitable for field trial after further toxicity tests had been carried out. Demidov (1959a) used Freon 112 in the treatment of 1,120 sheep using a dose of 200 to 300 mg. per kg. by injection into the rumen, and faecal examination 10 days later failed to reveal fluke eggs in the treated animals. Boray and Pearson (1960 a and b) carried out laboratory tests on 19 sheep carrying adult flukes and on 10 others carrying mature and young flukes using dose rates of 220 to 1,650 mg. per kg. The drug was mixed with liquid paraffin to give a 50 per cent. solution before use. Twenty-six animals were completely freed from adult fluke and the other 3 showed a 90 per cent. reduction in faecal egg count. Some of the immature flukes in the second group were not removed. In 3 field trials using doses of 220 to 660 mg. per kg. appreciable reduction of mature flukes was achieved but action against immature flukes was indifferent. Demidov (1959a) reported transient nervous symptoms in a few sheep which received 200 to 300 mg. per kg. but Boray and Pearson (1960) saw no evidence of toxicity in any of their sheep. Demidov *et al.* (1959) and Demidov (1959b) reported the drug to be effective in the treatment of fascioliasis in cattle.

Parasitic Bronchitis in Cattle and Sheep

Aerosol Therapy. In 1953 Enigk described an apparatus specially designed for the administration of anthelmintics in aerosol form by inhalation to cattle and sheep. The apparatus, which delivers 75 litres of aerosol per minute, was tested on 280 sheep and 31 cattle using 14 different anthelmintics. Oily solutions were more slowly absorbed than alcoholic ones, which readily penetrate the mucosa and are dangerous. Ascaridol was the most effective of the substances tested and the addition of 5 per cent. santonin increased its range of activity. Enigk (1955) confirmed the value of aerosol therapy using the ascaridol-santonin mixture applied for 15 to 20 minutes in cattle. A single treatment was adequate in early cases but repetition was necessary in severe cases. 5,670 cattle were treated by Enigk (1957) and 78 per cent. recovered or showed clinical improvement after a single treatment. In 1958 Enigk, Düwel and Federmann compared the efficiency of ascaridol aerosol, piperazine aerosol and cyanacethydrazine, and although the results varied with the degree of infestation the general conclusion was that the ascaridol aerosol was superior to piperazine or cyanacethydrazide. Langeler (1959) also concluded that aerosol therapy was highly effective and superior to cyanacethydrazide in uncomplicated parasitic bronchitis. Enigk (1953, 1955) also used the aerosol therapy in sheep and found ascaridol effective against *Dictyocaulus filaria* in 6 minutes. The addition of santonin improved the action of the aerosol against *Muellerius capillaris* and *Protostrongylus rufescens.* Enigk and Federmann (1958) regarded the aerosol therapy as unsuitable for sheep on account of the expense involved and because ascaridol is effective only agains *D. filaria.* Schulz and Heide (1959), however, found that the treatment could be economically applied to sheep by enclosing them in a small air-tight chamber but they also reported that small lugworms were unaffected.

Cyanacethydrazide. Walley (1957) using a new method of assay carried out critical tests demonstrating that cyanacethydrazide will remove lungworms from affected cattle, and showed that the drug may be given by the oral and the subcutaneous routes. He recommended a dose of 15 mg. per kg. for subcutaneous use and 17.5 mg. per kg. if given orally. Rubin (1959) carried out a controlled test using groups of 6 to 12 artificially infected calves. The drug was given at the rate of 15 mg. per kg. subcutaneously on 3 successive days and was found to be ineffective against worms 14 days old, moderately effective against worms 20 or 21 days old and fully effective against mature worms. Swanson *et al.* (1959) carried out laboratory studies on 8 naturally infected and 22 artificially infected calves and field studies on 200 calves, but were unable to show any benefit from the use of cyanacethydrazide. Rubin and Tillotson (1960) also carried out controlled tests on artificially infected calves which demonstrated the relative inefficiency of cyanacethydrazide against immature lungworms. O'Donoghue (1958) reported clinical improvement in 10 calves given 15 mg. per kg. either orally or subcutaneously, repeated after a week and again after a further 2 weeks. Rosenburger and Heeschen (1959) carried out a field trial on 26 farms involving about 500 cattle and concluded that badly affected animals did not respond to treatment, but that mildly affected animals ceased to excrete lungworm larvae and improved clinically. Zettl (1959) obtained satisfactory results in treating field cases although badly affected animals responded less well than those moderately affected. Enigk and Düwel (1959), however, obtained unsatisfactory results in treating some 200 field cases although the response was better in lightly infected animals. Walley (1957) reported that twice the therapeutic dose produces depression, inappetence and mild convulsions, and that three times the therapeutic dose caused fatal convulsions if given subcutaneously, although orally only depression and mild convulsions occurred. Rosenberger and Heeschen (1960) claim that the levulinic acid hydrazone of cyanacethydrazide is better tolerated than cyanacethydrazide itself. A 30 per cent. solution is given orally at a dose rate of 60 mg. per kg. on 2 successive days to 48 artificially infected calves and 1,073 field cases. Clinical improvement followed treatment in about 70 per cent. of cases.

Cyanacethydrazide has also been used in the treatment of lungworms in sheep. Walley (1957) found the drug to be active against *Dictyocaulus filaria* and *Protostrongylus rufescens* but not against *Muellerius capillaris* and *Neostrongylus linearia.* Wikerhauser *et al.* (1959) carried out controlled tests on sheep infected with *D. filaria* with good results. Vodrazka *et al.* (1960) carried out critical tests and could find no anthelmintic action against *P. rufescens* but against *D. filaria* a single subcutaneous dose was 79.5 per cent. effective and three doses 93.7 per cent. efficient. In the field O'Donoghue (1958) obtained excellent clinical results in 150 ewes and 60 lambs obtaining good results in severely affected animals. Heippe *et al.* (1959) and Jordan (1960) also obtained high efficiency and good clinical improvement.

Cyanacethydrazide has also been used in pigs, Walley (1957), Dick (1958) and Wikerhauser *et al.* (1959), and horses, Thomas and Jones (1960), but experience with these species is not extensive.

Diethylcarbamazine. Parker (1957) carried out controlled tests with diethylcarbamazine in calves artificially infected with *Dictyocaulus viviparus.* Treatment at the dose rate of 55 mg. per kg. was given daily for 5 days beginning 14 to 18 days after infection and was effective. Treatment given in later stages of the disease was less effective, death being delayed rather than prevented. In further tests Parker and Roberts (1958) showed that 5 daily doses of 22 mg. per kg. commencing 14 days after infection were also effective, but challenge on the 44th day after infection showed that the treatment had interfered with the development of immunity. In 3 controlled field trials in which animals were given 3 daily doses of the drug at the rate of 22 mg. per kg. Parker, Roberts, Vallely and Brown (1959) obtained a satisfactory clinical response including improved weight gain in 2 outbreaks. In the third depression of faecal larval output was achieved without clinical response but the outbreak was complicated by "virus pneumonia." Parker and Vallely (1960) using artificially infected animals compared the effect of a single dose of 44 mg. per kg. injected intramuscularly on the 14th day after infection with 3 daily doses of 22 mg. per kg. in 3 successive days. Although the single dose was not as effective in removing worms as the latter treatment it did remove a large number and would probably prove adequate in practice. Parker and Vallely (1960) showed that animals could tolerate doses of 440 mg. per kg. with only insignificant symptoms, and so the therapeutic dose has an adequate safety margin.

Diethylcarbamazine has also been used in sheep. Ozerskaya (1955, 1959) tested diethylcarbamazine citrate and phosphate in sheep. The citrate was injected subcutaneously into 18 sheep as a 1 : 3 aqueous solution at 100 to 200 mg. per kg. and in all cases excretion of larvae ceased 10 to 12 days after treatment and no worms were found at autopsy. The phosphate was given at the rate of 100 mg. per kg. to 14 sheep and all ceased to pass larvae in their faeces. Four animals were slaughtered and lungworms were found in only one. Kassai (1958) also tested the phosphate giving 200 mg. per kg. as a 1 : 3 aqueous solution repeated twice, by subcutaneous injection. Excellent results were obtained in the removal of *Dictyocaulus filaria* and *Protostrongylus* spp. but *Cystocaulus* spp. was only partially affected by treatment.

Tapeworms in cattle and sheep

Tin arsenate. Copper sulphate, copper sulphate-nicotine sulphate mixture and lead arsenate have been used now for a number of years as tapeworm remedies in cattle and sheep. Recently interest has been displayed in tin arsenate as a taeniacide in sheep. The drug has been used extensively in Russia: Grigoryan *et al.* (1958) reported its use in 13,000 sheep with good effect and without evidence of toxicity. Castel *et al.* (1960) have used the drug in

tropical Africa and have also reviewed the Russian work. They found that if the drug was given suspended in water to an unstarved sheep it was highly toxic. Given in capsules without starvation at the rate of 250 to 500 mg. per sheep the drug was safe and completely effective against *Moniezia expansa*. Given in capsules at the same dose rate after 20 hours starvation no toxic symptoms were observed and complete elimination of *Moniezia* spp., *Stilesia globipunctata* and *Avitellina centripunctata* was achieved. For *Moniezia* spp. a dose of 200 mg. per sheep in capsules after 20 hours' starvation is recommended, and if starvation is omitted then water should be withheld for 12 hours before, and 4 hours after, treatment. For the elimination of *Avitellina* and *Stilesia* a dose of 350 mg. per sheep given after 20 hours' starvation is recommended. Alternatively, a dose of 500 mg. per sheep can be given without starvation if water is withheld before treatment. The toxic dose is about 6 times the therapeutic dose and produces typical signs of arsenical poisoning. Animals receiving 250 or 350 mg. may safely be used for human consumption 6 or 7 days after treatment although it is advisable to discard the intestine and spleen.

Ascariasis in pigs

Following critical tests by Hall and Foster (1918) oil of chenopodium and santonin were widely used as ascaricides in pigs but these have been successively replaced by sodium fluoride, the cadmium compounds and finally by the piperazine compounds. More recently hygromycin B has also been used for the control of ascarids in pigs. The cadmium compounds have never been widely used in this country but most people are now familiar with the use of the piperazine compounds. These latter will be referred to briefly and hygromycin B in more detail.

Piperazine compounds. Sloan *et al.* (1954) administered piperazine adipate to pigs in wet mash and found it efficient. They recommend 300 to 400 mg. per kg. for field use. Leiper (1954) tested piperazine-1-carbodithioic acid and found a dose of 100 mg. per kg. administered individually to be 100 per cent. effective. At this dose rate 89 per cent. efficiency was recorded on a group of 6 pigs fed the compound mixed with the food. Guthrie (1956) and Guthrie and Briggs (1957) tested various piperazine compounds and found them efficient provided the dose rate was adjusted to give 110 mg. per kg. of anhydrous piperazine. Enzie *et al.* (1958) carried out critical tests with piperazine adipate and demonstrated higher efficiency in individually dosed animals than in pigs treated in a group, a feature already noted by Leiper (1954) but many authors report high efficiency under field conditions.

Hygromycin B. Goldsby and Todd (1957) fed hygromycin to pigs at the rate of 2 grammes of purified hygromycin per 100 pounds of food for 74 days. A slow decline in the faecal egg count of *Ascaris suum* over the period of treatment occurred but the result was considered to be inconclusive. Kelley *et al.* (1958) tested hygromycin B, the active principle of hygromycin, in naturally infected pigs. Hygromycin B was added to the food at the rate of 12,000,000 units per ton and fed for 60 days. One group of pigs was kept at pasture and another on concrete, and one month after treatment began the egg counts of both lots of pigs were practically zero whilst the counts of untreated controls were 5,000 per gramme or more. Ascarids were passed by the pigs and were found in the pens of those kept on concrete about a month after treatment began. Teague *et al.* (1958) carried out a field trial with hygromycin B in pigs. Pigs 9 weeks old were used in the first trial which was carried out partly in dry lots and partly at pasture; the pigs receiving hygromycin being fed rations containing 6,000 units of hygromycin B per pound. At the beginning of the trial none of the pigs was passing any ascarid eggs, but by the 112th day the control groups were passing 669 and 1,635 ascarid eggs per gramme. No ascarid eggs were recovered from the faeces of the 2 treated lots at any time during the trial. In a second trial carried out on a dry lot hygromycin was successful in keeping the faecal egg counts of the treated group at zero and no ascarids were found at *post-mortem* examination although an average of 30 ascarids was recovered from the controls. McCowen *et al.* (1959) carried out critical tests on pigs which had received 6,400,000, 12,000,000 or 25,600,000 units of hygromycin B per ton of food for 5 weeks. Only one immature ascarid was found in the group receiving the lowest concentration of antibiotic whilst worms were present in all pigs of the control group. Gossett and McCowen (1960) fed hygromycin B at levels of 10,000,000 to 80,000,000 units per ton of food and reduced the ascarid egg counts to zero in 33 days. At the end of the trial low or zero worm burdens in the treated group compared with 78 ascarids recovered from the control group. Subsequently McCowen *et al.* (1960) fed hygromycin B at the rate of 12,000,000 units per ton of food to weaning pigs for 42 days. A fall in egg count took place after feeding for 20 days and no worms were present at *post-mortem* examination. This work shows that the feeding of hygromycin B will control ascarids in pigs but that the antibiotic must be fed about 3 weeks before its effects are seen. For this reason Supperer and Pfeiffer (1960) point out that in heavily infected pigs a single dose of an anthelmintic such as piperazine is preferable. Lindquist (1958) was unable to control the migratory phase of the life cycle by feeding hygromycin to pigs. Kelly and Olsen (1959) also were unable to prevent the migration of ascarid larvae in pigs by the feeding of hygromycin but larval growth was retarded. Kelly *et al.* (1959) attempted to prevent the acquisition of ascarids by young pigs by feeding hygromycin B (6,000 units per pound of food) during gestation, but although the faecal egg count of the treated sows was reduced to a low level the piglets acquired ascarid infestation.

Oesophagostomiasis in Pigs

Piperazine compounds. Phenothiazine is an effective remedy for oesophagostomiasis in pigs but its use involves a considerable hazard of toxicity so that the piperazine compounds are now used for preference. Sloan *et al.* (1954) reported 80 to 90 per cent. efficiency with piperazine adipate in the removal of

Oesophagostomum spp. from pigs. Leiper (1954) found efficiency varying from 75 to 98 per cent. using piperazine carbodithioic acid at a dose rate of 100 mg. per kg. Enzie *et al.* (1958) carried out critical tests with a number of piperazine compounds against *Oesophagostomum* spp. in pigs, and using a dose rate of 110 mg. of piperazine base per kg. reported the following efficiencies: citrate 98 per cent., dihydrochloride 99 per cent., sulphate 80 per cent., adipate 69 per cent., and a mixture of the mono- and dihydrochloride 45 per cent. Using piperazine carbodithioic acid at the rate of 125 mg. per kg. in the food 84 per cent. of the *Oesophagostomum* spp. were removed. When given in the drinking water the efficiency dropped to 56 per cent., the water being distasteful to the pigs.

Hygromycin B. Goldsby and Todd (1957) showed that the feeding of purified hygromycin at the rate of 2 grammes per 100 pounds of food suppressed the egg laying powers of *Oesophagostomum* spp. in pigs. Discontinuation of the antibiotic resulted in an increase of the egg count to pretreatment levels and there was no evidence that the worms had been removed. Teague *et al.* (1958) also demonstrated this effect when hygromycin B was fed at the rate of 6,000 units per pound of food to pigs both at pasture and on dry lots. Gossett and McCowen (1960) fed various concentrations of hygromycin B from 8,270,000 to 80,000,000 units per ton, and at all levels noted a depression of egg production by *Oesophagostomum* spp. *Post-mortem* examination of the pigs after 5 weeks feeding of the antibiotic showed that the depression of egg count was the result of the elimination of the worms by the antibiotic. McCowen *et al.* (1960) fed 12 million units of hygromycin B per ton of food to 78 housed pigs and removed all the *Oesophagostomum* spp. after 5 weeks feeding.

Ascariasis in Horses

Piperazine compounds. There was no reliable ascaricide for horses until the advent of the piperazine compounds. Sloan, Kingsbury and Jolly (1954) first used piperazine for ascariasis in horses and showed that piperazine adipate at a dose rate of 250 mg. per kg. was highly effective, and at 400 mg. per kg. was completely effective. These results were confirmed in a series of critical and subcritical tests by Downing, Kingsbury and Sloan (1955). Poynter (1955a) found doses of 220 mg. per kg. given by stomach tube to be 100 per cent. effective, and later, Poynter (1955b) found the drug could be effectively administered in a bran mash. Later Poynter (1956a) compared the activity of 4 piperazine compounds—adipate, citrate, phosphate and carbodithioic acid, and found them all efficient as ascaricides provided the dose was regulated supplying 200 mg. per kg. of piperazine base. Poynter (1956b) made further studies with piperazine-1-carbodithioic acid and found 100 mg. per kg. completely effective against ascarids. This compound has also been extensively studied in America (Drudge *et al.*, 1957 a and b; Campbell & Kingscote, 1957; Clark & Connor, 1957). The latter workers demonstrated that the drug was effective against mature and immature worms. The drug is safe to use, Sloan, Kingsbury and Jolly (1954) having given doses as high as 1,500 mg. per kg. with no other ill effect than an increase in the fluid content of the faeces for 24 hours.

Strongylosis in Horses

Piperazine compounds. Phenothiazine became established as the most reliable drug for the treatment of equine strongylosis and is still widely used for that purpose. Although it can safely be used in the majority of horses a small proportion of animals have an idiosyncrasy to the drug and a number of deaths have been reported following its use. Downing, Kingsbury and Sloan (1955) carried out critical tests with piperazine adipate at a dose rate of 220 mg. per kg. on animals carrying strongylid worms and recorded 100 per cent. efficiency against *Trichonema* spp., 80 per cent. against *Triodontophorus* spp., 33 per cent. against *Strongylus vulgaris* and no effect against *S. edentatus* and *S. equinus*. Poynter (1956) demonstrated the high efficiency of the 4 piperazine compounds—adipate, citrate, phosphate and carbodithioic acid against strongylid worms except *S. edentatus*. Other critical tests by Gibson (1957), Drudge *et al.* (1957a) and field tests of Drudge *et al.* (1957b), and Clark and Connor (1959), support the earlier findings. The piperazine compounds have the same order of efficiency as phenothiazine against the strongyles and the additional advantages of being efficient ascaricides and non toxic. In consequence, they have replaced phenothiazine for routine use in the horse. Poynter and Hughes (1958) however, have demonstrated the considerable advantages which arise from the use of a mixture of these compounds. By means of critical tests they showed that a mixture of the 2 drugs was more efficient than either given alone especially against *S. vulgaris* and *S. edentatus*. The combination of drugs used was 670 mg. per kg. of phenothiazine with 220 mg. per kg. of piperazine adipate or 182.6 mg. per kg. of piperazine pyrophosphate.

Ascarid worms in Poultry

Piperazine compounds. Two ascaridoid worms occur in poultry: *Heterakis gallinae* and *Ascaridia galli*. Although the former worm is efficiently removed by phenothiazine the latter is not, but many workers have demonstrated the efficiency of the piperazine compounds against *A. galli*. Sloan *et al.* (1954) gave single doses of 150 mg. per kg. of piperazine adipate to birds and found the efficiency to be 97 per cent. The drug was also administered in the food with excellent results. Various concentrations from 1 : 350 for 1 day to 1 : 700 for 3 days were used resulting in an intake of 138 to 330 mg. per kg. Shumard and Eveleth (1956) gave piperazine citrate in the drinking water at the rate of 440 mg. per litre and 82 per cent. of the worms were removed. Horton-Smith and Long (1956) carried out extensive controlled critical tests with piperazine carbodithioic acid, piperazine adipate and piperazine citrate and complete control was achieved with doses of 100 to 500 mg. per kg. Some effect was also observed against the tissue phase of *A. galli*, 80 to 100 per cent. efficiency

following the administration for one day of 3,000 mg. of piperazine citrate per kg. of wet mash, or 1,500 mg. per litre of drinking water after starvation overnight. Worley *et al.* (1957) carried out critical tests with piperazine dihydrochloride, piperazine carbodithioic acid and piperazine hexahydrate against the tissue phase of *A. galli*. The first compound given at the rate of 25 mg. per day on day 7 to 14 after inoculation with eggs of *A. galli* showed considerable promise killing the tissue phase larvae. Thirty mg. of the second compound given on day 11 post inoculation was without effect, and the third given at the rate of 25 mg. per day on days 7 to 15 post inoculation was also effective against tissue phase larvae. These doses represent a total dose rate of about 200 mg. per kg. Many other workers have reported critical, controlled and field tests with the various piperazine compounds given individually to birds or incorporated in the food or drinking water, and the majority of the results are favourable. The drug can be considered non toxic. For example, Sloan *et al.* (1954) gave single doses of 1,000 mg. per kg. without ill effect and fed a 1:35 mixture in the food (10 times the therapeutic dose) and the birds remained normal.

Simultaneous treatment for *Heterakis gallinae* and *A. galli* is desirable, and Colglazier *et al.* (1960) have shown that 1 gramme doses of a 7:1 mixture of phenothiazine and piperazine removed 97 per cent. of the *H. gallinae* and all the *A. galli* from the treated birds. 0.75 gramme doses of a 12:1 mixture gave similar results.

Hygromycin B has also been tested for the control of *H. gallinae* and *A. galli* in poultry. Frazier (1959) used hygromycin in a flock of 1,970 hens feeding 8,000,000 units per ton of food for 8 weeks. *Post-mortem* examination of 1 per cent. of each group at intervals over a period of 8 weeks showed a decrease of infection from 23 to 0 per cent. in the treated birds. In 2 other field trials, one in which 8,000,000 units per ton of food were fed to a flock of laying birds for 12 weeks, the other in which 1,100 nine-months-old birds were fed 10,000,000 units per ton of food, *A. galli* was successfully controlled. Siegmann (1959) fed 0.5 g. of hygromycin B per kg. of food to 400 fowls for 8 weeks. *H. gallinae* was successfully eliminated and ova passed after treatment began failed to develop. In young chicks doses higher than 0.5 g. per kg. of food caused slight depression of growth. Siegmann and v. Bülow successfully controlled *A. galli* and *H. gallinae* in 154 naturally infected hens by feeding 0.45 per cent. of hygromycin B in the ration for 2 months. Egg production declined after laying hens had received the food for 3 weeks, but subsequently it surpassed that of the controls. Siegmann (1960) carried out a field test with 1,329 laying hens and 103 cockerels feeding 0.25 per cent. of hygromix in the food. Control of *A. galli* and *H. gallinae* was achieved and egg production improved in the treated group. Foster *et al.* (1960) fed hygromycin continuously to a flock of 1,133 pullets using 2 dose rates, 6 grammes and 12 grammes, of hygromycin B per ton of food. Little effect was seen on *A. galli* compared with controls, but effective control of *H. gallinae* was achieved. High production and an improvement of feed efficiency was noted. Twelve grammes per ton was thought to be in excess of requirements.

These preliminary results indicate that the level of ascarid infection in poultry can be controlled by the continuous feeding of hygromycin B but its status as a poultry anthelmintic has yet to be clearly defined.

Ascaridoid worms in the Dog and Cat

Piperazine compounds. The piperazine compounds have largely replaced the traditional remedies for the removal of *Toxascaris* and *Toxocara* spp. from the dog. Sloan *et al.* (1954) carried out tests with piperazine adipate on 13 dogs using dose rates of 25 to 200 mg. per kg. A *post-mortem* examination of one dog indicated that all the ascarids had been removed, and faecal egg counts of other animals were negative after treatment. Three cats were successfully treated using a dose rate of 100 mg. per kg. Mann *et al.* (1955) used piperazine citrate at the rate of 100 mg. per kg. each day for 10 days in 11 cats and 2 dogs. High efficacy was noted in all animals and as all worms were passed by the fourth day there was no advantage in continuing treatment longer. Bradley *et al.* (1956) carried out critical tests with piperazine citrate. Various dose rates were used and 176 mg. per kg. as a single dose was 100 per cent. effective. Mahmoud *et al.* (1958) also carried out critical tests with piperazine adipate in dogs which were treated after a 12 hour fast. 100 mg. per kg. given to 3 dogs was 87 per cent. efficient, 100 per cent. efficiency was obtained in 6 dogs given 200 mg. per kg. and in 2 which received 300 mg. per kg. Erhardt (1956) gave doses of 50, 100 and 200 mg. per kg. of piperazine hydrate to groups of 10 cats infected with *T. cati*. 100 per cent. efficiency was achieved in 3, 6 and 8 cats at the 3 dose levels. Erhardt calculated the effective therapeutic dose as 430 mg. per kg. but it should be noted that most of the cats receiving 200 mg. per kg. vomited. Sprent and English (1958) reported that piperazine adipate given at a dose rate of 200 mg. per kg. removed immature worms from puppies when treatment is given at 1 or 2 weeks of age. Hayes and McDaniel investigated the possibility of preventing the prenatal infection of puppies by administering piperazine adipate during gestation. Dose rates used were 100 mg. and 200 mg. per kg. per day or 200 mg. every 10 days during gestation. No effect was observed on the establishment of infection in the puppies. Toxicity studies have shown the drug to be well tolerated, Sloan *et al.* (1954) giving doses of 1,800 and 2,170 mg. per kg. without ill effect.

Hookworms in Dogs

Piperazine compounds. Tests with piperazine compounds have shown them to be unreliable in the treatment of hookworms but more efficient against *Uncinaria* spp. than *Ancylostoma* spp.

Bephenium compounds. Burrows (1958) tested the efficiency of bephenium chloride, bromide, iodide, hydroxynaphthoate and a mixture of embonate and hydroxynaphthoate in dogs infected with *Ancylostoma caninum*. Dose rates from 10 to 100 mg. per kg. administered to 50 dogs. Critical tests showed doses

of over 20 mg. per kg. to be 99.4 per cent. efficient. Doses of 20 mg. per kg. or less were 94.1 per cent. efficient. Nausea and vomiting were seen in some dogs which received doses of 50 mg. per kg. or more, but were rare in dogs receiving 20 mg. per kg. Seneviratra (1960) used doses of 20 mg. per kg. on 20 dogs. On egg count data and clinical effects the drug was considered highly efficient. Burrows *et al.* (1960), in a preliminary communication, described a compound related to bephenium which is as effective as bephenium chloride but less prone to produce emesis. Further details of this compound are awaited.

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THE SPEAKERS' INTRODUCTION

The Chairman, Dr. N. S. Barron, said the first speaker was Dr. E. J. L. Soulsby who, after a brief sojurn at Bristol University, went to Cambridge where he spent 8 years on the particular subject which he was proposing to review.

The second speaker was Dr. T. E. Gibson who had spent 19 years at Weybridge in the same department, after having spent 8 years in practice. Dr. Gibson had done a great deal in those 19 years for which the profession were grateful.

Dr. E. J. L. Soulsby said it gave him great pleasure to present his paper at the British Veterinary Association Congress in Oxford, particularly as 4 years ago in Cambridge he had the privilege of introducing a similar paper entitled "Some Immunological Phenomena in Parasitic Infections." Since that time substantial advances had been made in the field of immunity to parasites. There was now a practical field vaccine for lungworm disease in cattle. *In vitro* cultivation of parasitic nematodes was well advanced and vaccines prepared from *in vitro* cultured forms had made substantial progress. It was particularly appropriate that the Congress should be discussing the control of parasitic diseases since the World Health Organisation was initiating a programme for the diagnosis and control of helminth diseases of man and the knowledge applicable to animal parasites was very pertinent to those in man, particularly from the immunological aspect.

The fundamental mechanisms of immunity to helminths were gradually being understood, and because of that there was now a much clearer concept of the phenomena and it was possible to plan control measures accordingly. Thus the moulting phase had been shown to be an important time for the release of functional antigens and also a time for the attack by the immune mechanism. Another important concept was that not all larval stages of a helminth were the same; they differed antigenically and they also differed in their immunising capacity. It was not known how many larval phases must be undergone before satisfactory immunity was induced in all infections. In the case of *H. contortus* it appeared that larvae need only reach the fourth larval stage having undergone one moult. In *Trichinella spiralis* infection, on the other hand, a virtually adult infection was necessary before good immunity was produced. It was possible in natural infections that various larval stages must be undergone in order to provide enough protective antigen, but in artificial vaccination it might be possible to do that by giving a single larval phase in amount much greater than an animal would normally be able to withstand in natural infections. On the other hand, there were probably qualitative differences between various stages and that was suggested from serological tests which showed a varying serological response to various developmental stages during infection.

Little information was available as to how helminths were affected by the immune processes or on the relative importance of antibody and white cells. There could be little doubt that the immune mechanisms had an antibody basis but circulating antibodies did not appear to be of paramount importance as, for example, in anti-toxic immunity. The mechanism was more of the anti-invasive type and white cells were likely to play an important part in that mechanism. *In vitro* work had shown that white cells particularly eosinophils become adherent to larvae. There was now more evidence that they also functioned *in vivo* and that cells could migrate through the intact intestinal epithelium to attach themselves to larvae in the bowel lumen. Because of the interest in the cellular elements the cell proliferations in the mucosa of the intestine in immune animals were receiving greater attention. For example, such cells as the globular leucocyte were to be found in large numbers during an immune reaction in the bowel wall. The function of those cells was not as yet fully understood, but using fluorescent antibody techniques it could be shown that they contained antibody.

How could those immune reactions be used for control? The possible methods of inducing functional immunity artificially were as follows: (1) The use of standardised doses of normal infective stages. (2) The use of closely related species of parasites or those with reduced virulence. (3) The use of artificially attenuated infective stages. (4) The use of materials obtained from parasites cultured *in vitro*.

The use of standardised doses of normal infective larvae was generally inapplicable, particularly since a patent infection would occur and which might initiate disease in an otherwise normal population. However, the advent of larvicidal antihelmintics might make this a satisfactory method in that normal infective larvae would be given to an animal and the infection terminated by anthelmintics when the larval phase which induced immunity had been reached. Such a method was used in the control of coccidiosis in chickens.

Though the use of closely related species or those with reduced virulence had had wide application in other infectious diseases, little information was available on this in helminth infections. It was unlikely that much cross immunity would exist between species, but it would appear worth while to search for variants within species.

Since no satisfactory method existed at present to utilise the above systems the latter two, the use of attenuated infective stages and the materials obtained from *in vitro* cultivation, offered the best hope at present of control by immunological means.

The most popular method of attenuation was the exposure of infective stages to X-rays, when the ability to reach the adult stage was greatly reduced or eliminated. The first vaccine of that type, for lungworm disease in cattle had been highly successful. Experimental work had been published on the use of X-irradiated larval vaccines for *H. contortus, Trichostrongylus* spp. and the dog hookworm *Uncinaria stenocephala*. The particular attribute of that type of vaccine was that while the immunising phases of the life cycle were undergone, adult infection and clinical disease was avoided. The number of larvae reaching the adult stage in such vaccine was low and in an area where the parasitic disease was endemic such patency was of little importance. In areas where parasitic disease was sporadic, however, those patent infections might lead to clinical disease in non-vaccinated animals.

Vaccines made from materials obtained from *in vitro* cultures of parasites were at present in the development stages, but it was likely that they would be available commercially in the near future. In those vaccines it was anticipated that the infective stages of various helminths would be cultured to a stage where they produced the essential functional antigens which would have been produced in the animal if the larvae had been given as a normal infective dose. It was assumed that such vaccines would be preserved in a freeze dried state and would be administered parenterally to the animal.

In many cases the use of a vaccine would give "epidemiological control." Thus it was not envisaged that absolute immunity would be produced which would protect an animal for life. It was known that in the absence of infection, immunity in many parasitic diseases waned rapidly. Vaccines, particularly against intestinal helminths of sheep and cattle, would probably be used to prevent clinical disease rather than to render the sheep completely free of worms. They would be used at times when it was anticipated that a marked challenge to the host would occur. For example, lambs at weaning time might well benefit from a vaccine against the gastro-intestinal worms. That would give them some degree of protection for the rest of the year. Similarly, the older members of the flock would benefit from a vaccine in the late winter to boost their immunity and prevent or greatly reduce the marked increase in helminth burdens which occurred in the spring time.

As well as being of use as an artificial control measure, immunity played an important part in the epidemiology of parasitism in animals. The relationship between the host and the parasite was a delicate one and could be easily upset. There were cases of frank parasitism which required anthelmintic therapy, but in other situations the iniudicious use of anthelmintics might have an adverse effect on the host from a parasitological point of view. In that respect the adult stage of a helminth seemed to exert a particularly important influence on the helminth burden, especially with regard to the suppression of growth of larval stages. There were instances where the removal of the adult worm led to a reactivation of inhibited larval stages with subsequent effects in the animal. For example, in *H. placei*, the removal of adult worms might lead to the activation of a large number of dormant larval stages which might in fact kill the animal. In *Trichonema* spp. in horses, the removal of adult worms allowed larval stages to recommence growth. Possibly in *Ostertagia* infection in cattle a similar phenomenon might take place leading to parasitism under conditions of husbandry which at first sight would not appear conducive to parasitism. Recent work with naturally occurring helminth populations of sheep had shown that phenothiazine therapy might have little effect on the seasonal variation in helminth populations. In certain circumstances it might have an adverse effect. For example, in sheep undergoing the spring rise phenomenon the use of phenothiazine did not prevent the spring rise and might in fact interfere with the curative mechanism that terminated it. In such circumstances anthelmintics should be used with discretion and be used only when they were necessary. Under conditions of good husbandry there should be little need for the repeated use of anthelmintics.

It was unlikely that parasitic infection would ever be eliminated, unless animals were produced and reared as pathogen-free animals. Good management would do much to maintain the balance between host and parasite, but the use of vaccines would allow for the prevention of parasitic disease. In the next few years, a new era in the control of parasites was likely, vaccines taking their place with anthelmintics.

Dr. T. E. Gibson said that when it was introduced some 20 years ago, phenothiazine was without doubt a considerable advance on the anthelmintics then available for the treatment of parasitic gastro-enteritis in cattle and sheep; but since that time its disadvantages had become manifest and attempts had been made to improve its activity and to find superior compounds. Investigations had shown that the particle size of phenothiazine preparations influenced their anthelmintic activity, but the optimum particle size range for the elimination of any particular species of parasite had not been worked out. The investigations conducted up to the present showed that fine grinding increased the activity of the drug against the species of *Trichostrongylus* found in the small intestine. Fine grinding also enabled the dose rate to be lowered for any particular degree of anthelmintic efficiency, but the latest work showed that high efficiency could equally well be achieved by a low dose of fine particles or a higher dose of coarser ones. The increased absorption which would occur with finely ground preparations seemed likely to increase the hazard of toxicity especially in cattle and there had been considerable reluctance to use finely ground phenothiazine in cattle. Armour, *et al.* (1961) however, had used it in cattle in Nigeria and found doses of 110, 220, and 330 mg. per kg. effective against *Haemonchus* spp., 220 and 330 mg. per kg. effective against *Oesophagostomum radiatium* and *Trichostrongylus* spp. whilst 330 mg. per kg. was effective against *Bunostomum phlebotomum*. *Cooperia* spp. was not effectively removed at any of the dose rates used. Toxicity was observed in 2 animals given 330 mg. per kg., one of which died. The authors considered fine particle phenothiazine to be useful under Nigerian conditions and were further investigating the toxicity of 330 mg. per kg. doses.

Recent work had shown that certain organic phosphorous compounds acted synergistically with phenothiazine, thus enabling the dose of the latter drug to be reduced. Kingsbury (1961 a and b) produced evidence that coumaphos and its phosphorate derivative coroxon synergised the action of phenothiazine. 200 mg. per kg. of phenothiazine with 2.0 to 2.5 mg. per kg. of coumaphos or 1.5 to 2.0 mg. per kg. of coroxon being extremely active against *Haemonchus contortus, Trichostrongylus* spp., *Ostertagia* spp. and *Strongyloides papillosus*, in sheep. Subsequently, Sloan, Wood and Rawes (1961) carried out field trials with the coroxon-phenothiazine mixture and the results confirmed those of the previous laboratory trials. No toxicity was reported by any of those workers, but there had been a number of reports from the field of toxic effects, including death, following the use of the mixture.

The deficiencies of phenothiazine as an anthelmintic for cattle had prompted the search for alternative comnounds. Several of the organic phosphorous compounds had been examined but only Neguvon had shown sufficient promise to be placed on the market. At 110 mg. per kg. it was very active against *Ostertagia ostertagi* and *Cooperia* spp. two nematodes which caused serious disease in cattle. Although some workers had given high doses without signs of toxicity deaths had followed the use of therapeutic doses. Toxicity was so unpredictable that it was advised that animals should be observed for an hour after treatment and atropine kept in readiness in case any signs of toxicity were shown.

A compound which showed great promise as an anthelmintic in cattle and sheep was methyridine, which can be given by subcutaneous injection or orally. It had a wide range of activity against nematodes of both sheep and cattle and was particularly useful in combating ostertagiasis and cooperiasis in cattle against which phenothiazine had indifferent action. In therapeutic doses the drug was not toxic but twice the therapeutic dose would cause toxic symptoms in a proportion of animals. The

greatest drawback of the compound was the production of local reactions at the site of injection in some treated animals, cattle being more prone than sheep. Division of large doses and the avoidance of parts of the body where much movement occurred as injection sites could do a good deal to reduce that hazard.

The bephenium compounds were completely effective in nematodiriasis and the hydroxynaphthoate should be used on account of its superior action against other gastro-intestinal nematodes compared with the embonate. The bephenium compounds had the unusual property of high activity against the immature forms embedded in the mucous membrane of the gastro-intestinal tract, and that, in fact, made them of unique value in the treatment of nematodiriasis.

Carbon tetrachloride had been the standard remedy for fascioliasis for many years although it had been replaced by hexachloroethane in cattle in the last decade. The parenteral use of carbon tetrachloride was first used as long ago as 1927 but in this country it was only in the last few years that it had been used in that manner. The drug had been given by subcutaneous and intramuscular injection in a variety of vehicles including liquid paraffin, vaseline, fish fat and petroleum. The drug had been administered in that way mainly to sheep and there was general agreement as to its efficiency, although it often caused pain at the injection site and muscle necrosis might be seen on *post-mortem* examination. A number of workers had incorporated a local anaesthetic in order to minimise the pain caused by the injection. The drug had likewise been used in cattle with similar results. Boray and Pearson (1961) had recorded its use in 315 cattle in nine herds with a high rate of successful treatment and no evidence of toxicity. They pointed out that the method had considerable advantages in the treatment of intractable animals.

Carbon tetrachloride had the disadvantage of poor action against fluke less than 8 weeks old, which made it of little value in the treatment of acute fascioliasis. Three new compounds had recently been tested as fasciolicides, but 2 of those, hetol and difluorotetrachloroethane (Freon 112) had no appreciable action against immature flukes. Preliminary work carried out by his colleagues, S. B. Kendall and J. W. Parfitt at Weybridge had, however, shown that the third compound, hexachlorophene, at a dose rate of 40 mg. per kg. was partially effective against flukes 2 weeks old and fully effective against flukes 3 weeks old. There was, however, evidence—Guilhon and Graber (1961)—that doses of 40 mg. per kg. could be toxic and further work was necessary on activity of hexachlorophene against the immature fluke and the toxicity of the active dose range.

In the treatment of parasitic bronchitis 2 drugs had now been brought into use: cyanacethydrazide and diethylcarbamazine. It was clear from the published work that whilst cyanacethydrazide was effective against mature worms and not against immature forms the reverse applied to diethylcarbamazine. In practice, therefore, it was not surprising that neither of those drugs had been the complete answer to the treatment of parasitic bronchitis and on theoretical grounds the use of both drugs together would be sound. The problem of a satisfactory treatment of parasitic bronchitis in the field had yet to be solved.

Tin arsenate had recently been introduced in Russia and tropical Africa as a taeniacide in sheep. In this country where only *Moniezia* was a problem tin arsenate had no special advantage, but in countries where *Stilesia* spp. and *Avitellina* spp. were common it should prove useful.

In pigs a succession of ascaricides had been used: oil of chenopodium, santonin, sodium fluoride, cadmium compounds and finally the piperazine compounds. The latter were now widely used and had the additional advantage of effective action against *Oesophagostomum* spp. as well. The antibiotic Hygromycin B had also been widely used in the United States for the control of worms in pigs and poultry. It was given as a food supplement and caused gradual loss of the worm burden. If feeding was stopped too soon the worms recovered and continuous feeding was necessary for effective action. Hygromycin B was useless to control heavy established infections which must be removed using piperazine before hygromycin feeding was attempted.

The piperazine compounds had also been found to be effective non-toxic ascaricides for the horse. They were also as effective as phenothiazine against the strongylid worms and had, therefore, tended to replace phenothiazine as equine anthelmintics. It had, however, been recently shown that a mixture of the 2 drugs was the most effective anthelmintic yet devised for the horse having high activity against ascarids, the small strongyles and also the large strongyles which were notoriously difficult to remove.

In poultry phenothiazine was a satisfactory anthelmintic against *Heterakis* spp. but its action against *Ascaridia* spp was indifferent. The piperazines were very efficient against that latter species and both drugs could be conveniently administered in the food. Hygromycin B could also be used as a food additive to control worms in poultry and it had been widely used in the United States.

In dogs and cats the piperazine compounds had been found to be efficient ascaricides and they might be used to remove immature worms from young puppies. They could, therefore, be used to remove prenatally acquired infections in young puppies in order to reduce the risk of visceral larva migrans in man. Piperazine compounds had, however, proved valueless when given to bitches to prevent the prenatal infection of puppies. The treatment of hookworm infections in dogs had always been a difficult problem, but recent observations had shown the value of the bephenium compounds for their elimination. Those compounds had the disadvantage of causing vomiting in a high proportion of dogs. Rawes and Clapham (1961) had reported the action of the related thenium p-chlorobenzene sulphonate as highly effective against *Ancylostoma caninum* and *Uncinaria stenocephala* at a dose rate of 200 to 250 mg. per kg. morning and evening. That drug also caused vomiting in some dogs, particularly young puppies, but the incidence of vomiting was considerably lower than with the bephenium compounds.

That was a brief summary of recent progress in veterinary anthelmintic medication, but it was by no means the end of the story. Chemotherapeutic research was being carried out actively in many countries, and one could probably look forward to the discovery of yet more efficient anthelmintics in the near future.

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The Opener

Mr. J. A. Pasfield, in opening the discussion, congratulated the Provisional Committee on the way in which they had contrived 2 opposed yet complementary lines of approach to a subject which, to judge from the frequency with which it was discussed by the Association, was both important and topical. Nothing could have been more apt to present-day thought, when the arguments for eradication or adaptation ranged through the fields of epizootic disease, crop husbandry, and even human relationships. He also thanked the speakers most sincerely for the great amount of reading they had incorporated into their papers, as evidenced by the number and diversity of the references they had quoted. Finally, he supposed that the Provisional Committee had done him the honour of opening the discussion to find out what sort of impression this mass of facts and observations made on the man in the field, and to have the comments of the average practitioner.

Dr. Gibson stated a truth—and perhaps understated it—

when he said that scarcely a week passed without the discovery of some new compound of potential anthelmintic value, and in fact since receiving his paper, a new compound, thenium, active against hookworms and roundworms in the dog had been described in THE VETERINARY RECORD by Rawes and Clapham. Most people engaged in veterinary commerce knew that more chemical compounds were evolved each week than there were scientists to evaluate, and that quite probably chemotherapeutic compounds of great value lay unrecognised and untried. The bench number alone of some new compounds was enough to give an idea of that. If the assessment of new compounds was more than a match for the available scientists, how much more so must it be for the practising veterinary surgeon, and how much more implicitly must he now rely on what he was told. He could only hope that the producing house had conducted leisurely, thorough and extensive field trials, and that it had been as honest with itself as it hoped to be with the agricultural public, knowing that he was likely to be asked to use, whether orally or parenterally, compounds which regrettably tended to be ever more poisonous or unacceptable to the living tissue in which they were to be lodged.

Generally speaking, the internal parasiticides had always been dangerous and potentially toxic to the host. Great care needed to be exercised in assessing dosage rates, having regard to the physical condition of the recipient, diet, debility, pregnancy, and so on. Even such relatively mild agents as phenothiazine, piperazine, and santonin were not entirely without undesirable side effects. Thus, although it was a widely held point of view that modern agriculture made far too free a use of dangerous chemicals in its efforts to control pests and parasites which were currently held to be obnoxious, it was a logical sequence that the organophosphorous group should appear, bearing in mind that a number of new chemotherapeutics were by-products of the general chemical manufacturing industry for which it was convenient, and sometimes profitable, to find a use in medicine or agriculture. It was with relief, therefore, that one read the work of Kingsbury and others in modifying the toxicity of the organophosphorous compounds by combining them synergistically with phenothiazine, and it was to be hoped that that line of investigation would prove fruitful.

While on the subject of the more toxic parasiticides he referred to paragraphs on pages 1064 and 1065 of Dr. Gibson's paper concerning tapeworm of cattle and sheep, but in which the references were almost entirely to sheep. He found that in the last 12 months in practice, of 104 faecal samples from horses and cattle submitted for laboratory examination, about 4 per cent. had been returned positive for tapeworm. Four per cent. was not great, but it was troublesome, and he had the impression that taeniasis was more widespread among dairy cattle than one would think. Dr. Gibson's comments on the transmission and control of tapeworm in large farm stock would be appreciated, and also a few comments on the treatment of oxyuris in the horse, which did not seem to have advanced markedly in the last century.

He had rightly drawn attention to the need for some better means of controlling infestation with the *Ostertagia* group, which could play havoc with young cattle before satisfactory diagnosis was established. One had difficulty in assessing the possible toxicity of a new parasiticide under field conditions. For example, Riek and Keith in 1958 reported only slight and transitory toxic symptoms in calves following the use of the organophosphorous compound Neguvon at a rate of 110 mg. per kg., whereas Michel and Banks in 1960 reported severe reactions following the same dosage rate with death occurring within 30 minutes. Although that might be a little outside the bounds of his paper, he would ask Dr. Gibson whether any improved methods for the earlier diagnosis of ostergiasis were available or under consideration.

Dr. Gibson considered the use of aerosol therapy in the control of parasitic bronchitis. Treatment by direct inhalation was, of course, a very old-established system, one of the earlier medications of choice being iodine fumes—sometimes a dangerous procedure. It was difficult to help thinking that most older practitioners looked back to the days of direct intratracheal injection with a sort of nostalgia. Perhaps they liked to remember their youthful strength and agility! Certainly the weird concoctions made up in the dispensary were toxic enough and ought to have been attended by dire pneumonic results. But often enough they appeared to work. Treatment was generally accompanied by some unpalatable advice about housing and feeding young stock. The natural reluctance of a stockkeeper to waste grazing or fine autumn days was a major factor to be considered in the control of parasitic bronchitis of young cattle. It was remarkable with what regularity and severity the condition recurred with those stockowners who were known to be tightfisted about supplementary feeding towards the end of the summer. It was here that one began to see the value in pounds, shillings and pence, of the application of the knowledge of those immune mechanisms detailed in Dr. Soulsby's papers. But to return to the aerosol therapy, it seemed reasonable to expect in the future, when stock specialisation was more widely accepted as an agricultural practice, and where a continued high rate of stocking was accompanied by poor quality rations, that part of a farm building might be designed specifically for the purpose of applying aerosol therapy, not only for the control of pulmonary infestation, but for that of ectoparasites as well, and that in such an event aerosol therapy might be much more widely used.

Clearly, some knowledge of the mechanisms of immunity was required by the practitioner who intended to control dictyocaulus viviparus infestation by using X-irradiated larval vaccine. That statement was justified when one considered breakdowns in the field. Not only must he consider the possibility of infestation, however slight, existing at the time of vaccination; but he should have knowledge of what other conditions were endemic to the farm, particularly those of a pulmonary character, and he must take into consideration the possibility of the subsequent infestation of vaccinated calves by gastro-intestinal helminths. Breakdowns, though not common, were disturbing to practitioner and stockowner alike, the more so since massive loading of the lungs with mature lungworms could often be observed at *post-mortem* examination. No doubt there were several present who would like to have Dr. Soulsby's comments on that kind of breakdown, and whether, for instance, he thought the use of irradiated vaccine against *Dictyocaulus viviparus* ought to be routinely accompanied by more than visual examination of calves, or by a general control of intestinal parasites to which that of the lungworm was complementary.

It was sometimes useful to redefine what was meant by a parasite. No doubt Mr. Kruschev had quite a different idea from Dr. Taylor! Dr. Taylor had been known to argue lyrically to the Association that there was such a thing as a worm's-eye view, and that good parasites deserved good hosts. By definition a parasite was one who ate at another's table. The definition did not specify whether he gave anything in return; but it might fairly be assumed that at least his conversation was agreeable, and logically the parasite could be called an aid to digestion! Naturally, too many parasites would eat the host out of house and home. The poet Homer was well aware of that and committed his hero Odysseus on his return to a policy of eradication. Dr. Soulsby's paper indicated that the parasite very definitely offered something in return, even if it were only the ability to tolerate his presence, and that line of investigation opened an enormous field. It was to be hoped that he might not be accused of parochialism if he commented that the control of parasitism by eradication alone offered little to the practitioner, who already saw agri-business moving into the field ahead of him with bigger and better parasiticides over which he had no control, whereas an appreciation of those mechanisms which influenced the host-parasite balance should bring into play just those skills which the veterinary surgeon, by training, instinct and environment, and by his knowledge of the principles of sound animal husbandry, was best fitted to exercise. He knew that he had the highest precedent if he recalled a passage from the Gospel of St. Luke which illustrated that clearly: "When the unclean spirit is gone out of a man he walketh

through dry places, seeking rest; and finding none he saith, I will return unto my house whence I came out. And when he cometh he findeth it swept and garnished "—the operative phrase—" Then goeth he and taketh to him seven other spirits more wicked than himself, and they enter in and dwell there." It was not necessary to remind those present of the last phrase of the passage, which 2,000 years ago put its finger upon the basic difficulty of control by eradication alone, that " the last state of that man is worse than the first."

The 2 papers had together shown that what appeared to be diametrically opposed lines of approach were, in fact, complementary, and that future control of the host-parasite balance would depend on ability to combine them intelligently. Farming methods were changing, in his view in favour of the parasite. What Dr. Gibson and Dr. Soulsby had said, and the points which no doubt would arise in the discussion, would be of the greatest value to all who were concerned in that field.

The General Discussion

Mr. J. B. White (Salisbury) said he was interested in Dr. Soulsby's view that it was still better to maintain a host-parasite balance by means of good feeding, rather than perhaps by the excessive use of anthelmintics. Mr. White agreed with that entirely, but the question of what sort of good feeding was to be used had to be faced. Probably one could not continue to feed cakes or dry feeding to the extent which was possible in the past, and the whole trend at the present time was to make more and more use of the increasing yield of grass which it was possible to grow. If one were to use grass more, then it was logical to suppose that one would step up the worm burden more, and in those circumstances could a system be evolved by which that increasing burden could be made to balance the host immunity?

Work had been done in some fields, for instance, with ewes and lambs, using a side by side system of grazing in which the lambs got the last of the grass and the ewes were kept on relatively restricted grazing, which seemed to give quite good results. But on a large scale it was not so easy to apply, and it would be interesting to hear whether Dr. Soulsby has any views on what might be the outcome of the increased use of grass. Also, would the very high kills which were now possible with the new drugs such as Neguvon upset the normal development of immunity? They would in all probability not be used until one had clinical signs of disease, and by the time the signs arose the immunity response would already have been stimulated.

Mr. White said he also wondered whether Dr. Soulsby considered that it might be a possibility in the future to produce a mixed vaccine, one covering both husk and intestinal parasites as well. It would seem reasonable because the host itself developed the immunity at the same time against the different parasites under natural conditions.

He also desired to ask Dr. Gibson whether there was anything new for the treatment of *Hyostrongylus rubidus* in the adult sow. It was still not easy to deal with. It was not common, but one saw it in a sow suckling a litter of 5 weeks, and she went to pieces very quickly.

Mr. Pasfield's aerosol treatment was interesting. The earliest air treatment which Mr. White remembered was when he was a boy at school. In those days the stable would be packed tightly with heifers, and sulphur would be thrown on to a bucket containing burning coke. The workers would stay in the stable until they could stick it no longer and then they went out leaving the animals in for another 3 minutes!

Mr. J. W. G. Leiper (Thurgarton) said it would seem that there were 2 lines of approach to the control of helminth infections and that they were complementary. A greater knowledge of the immunity to helminths would be essential in order to find out the best way to use anthelmintics to give control of pathogenic burdens and yet allow natural immunity to develop. Eradication may ultimately be possible and this might either be accomplished by the development of efficient vaccines or by the use of more efficient anthelmintics.

With regard to piperazines, Dr. Gibson had pointed out that these drugs are of little use in sheep; it was presumed he was referring to sheep in the U.K. because in certain other countries, particularly Australia, where the nodular worm occurs, piperazines have been found to be of particular value.

A new anthelmintic which had not yet been mentioned was the Merck compound Thiabendazole. A recent paper by Brown *et al.* in the *Journal of the American Chemical Society* (1961) **83,** 1764, reported the broad spectrum activity of this compound against helminths of farm animals. Work at Thurgarton had confirmed these results, particularly for sheep, against a wide range of adult and immature gastro-intestinal nematodes. More recently in the *Australian Veterinary Journal* (1961) **57,** 264, Hebden had shown it to be very effective at 50 mg. per kg. against almost all the gastro-intestinal nematodes of sheep.

Mr. P. J. Daly (Republic of Ireland) said he spoke as a practitioner whose nearest laboratory was 150 miles from where he worked, and in the field problems arose from time to time upon which it was necessary to decide on a certain line of treatment. His comments would be chiefly concerned with fascioliasis as it was encountered, particularly in the pregnant ewe. The line of treatment adopted would depend on what type of diet the pregnant ewe was having and what stage of pregnancy she had reached. Sometimes the condition was encountered when the ewe was about to drop, and in that case the lines of treatment varied. In cases of acute fascioliasis one had no option but to go ahead, and in such cases he had used carbon tetrachloride and liquid paraffin injection with good results. If the picture were not so urgent, he had found hexachl or ethane was the drug of choice, having taken the necessary precaution of withholding carbohydrate diet for 2 days before dosing. In the ewe which had recently dropped he preferred malefern.

Referring to parasitic gastro-enteritis in lambs, he had found that it was accompanied by taeniasis, and the routine line of treatment was very effective. He used copper sulphate and nicotine sulphate followed in 2 days by a massive dose of fine phenothiazine, and should the result be not completely satisfactory then he resorted to Neguvon.

Mr. J. W. G. Leiper referred to Dr. Soulsby's paper and said he was surprised at his spring rise graph. He had carried out an experiment 10 years ago to see whether phenothiazine would cut out spring rise. He gave it to pregnant ewes a few weeks before they lambed. Then he gave them small doses during a period of some 6 weeks or so. In the case of the dosed ewes the graph was straight, whereas in the case of those which remained unmedicated there was a spring rise. One could only suggest that Dr. Soulsby did not use pure, fine phenothiazine!

The Replies

Dr. E. J. L. Soulsby, in reply, said that Mr. Pasfield asked about the routine use of lungworm vaccine. There could be little doubt about the value of the vaccine. Generally it seemed to be useful to use it as a routine. One must remember that the immunity to the helminth was not life long. In the absence of restimulation it would wane. Consequently, on a herd basis, although the animals had been vaccinated once, if it were in a herd in which there was very little lungworm trouble, it was always appropriate to vaccinate the following year. It was a specific immunity for the cause of parasitic bronchitis in cattle. Although animals were immune to bovine lungworm, they were not necessarily immune to intestinal worms, so it would be necessary to think in terms of controlling intestinal worms as well. That was possibly one of the dangers of the use of vaccine, since it was still in the minds of many people that a worm was a worm and it did not matter what it was called! Therefore, the use of lungworm vaccine did not eliminate consideration for the control of other worms.

Mr. White put his finger on the point. He would doubtless agree that by good husbandry, and by that Dr. Soulsby said he meant more than good feeding, a great deal could be done to maintain the balance between host and parasite. Obviously grass was being used much more now. It was difficult, of course, to think in terms of controlling parasites by simply leaving the animal to do it by itself and with the

increased use of grass and the general tendency to keep more animals per acre of grass, anthelmintics had to be used. It was necessary to break down the flock into separate units, depending on what one wanted to do. For example, it was the young animal which was particularly prone to parasitism, and consequently it was the young animal which needed to be protected. It was possible to rear lambs for a short period of time completely free of helminths and so produce a fat lamb in a short period of time without any parasites at all, or very few. For the production of fat lamb this was ideal, but if the animal were to go on into the main flock, it needed a degree of immunity. Where the increased use of grass was occurring and the parasite burden increasing, then particular attention should be paid to the young animal, and anthelmintic measures would be necessary, particularly at the height of the challenge, which was in mid and late summer.

An adult sheep at that time would also serve a useful purpose. Dr. Taylor, as usual, put it succinctly. He likened the adult immune sheep to a vacuum cleaner—capable of taking in infective larvae but destroying them by immune mechanism, and therefore limiting the severity of gastro-enteritis in the flock as a whole. Some work was done in Australia by Gordon on the frequent use of anthelmintics and the effect of this on the immunity of the flock as a whole. Gordon found that if anthelmintics were used too frequently, the general immune status of the flock was interfered with so that if anthelmintics were discontinued for any reason, the flock was at a disadvantage if at a later period of time it received a challenge.

In reply to Mr. White, he felt sure that it would be possible to have a mixed vaccine. Bearing in mind that each parasite had its own specific immunity and that one parasite would not protect against another, it would be necessary in Britain to have at least 3 species in a vaccine.

He was aware of Mr. Leiper's earlier work. The dose given was the routine dose used in the flock but it was given only to a certain group of the flock. The result was that the acquisition of immunity was interfered with. A low level dosage system was not employed.

In another 4 years or thereabouts in his view many more vaccines for helminths would be available.

Dr. T. E. Gibson, in reply, said that in his paper he had dealt chiefly with taeniasis in sheep as more work had been carried out with sheep than with cattle. It was unfortunate that the gastro-intestinal parasites of cattle had received so little attention until recent years. Copper sulphate and lead arsenate had both been used to remove tapeworms from cattle but there were reports that colic and other toxic symptoms had followed the use of the latter drug in some animals.

In the treatment of oxyurids in horses, the best drugs appeared to be the piperazine compounds which were reported to be 80 to 100 per cent efficient. Some workers had, however, reported much lower efficiency and the action against immature oxyurids appeared to be particularly variable.

The diagnosis of ostertagiosis was a difficult problem chiefly because the greatest damage was done by the immature worms which were not detectable by the faecal egg counting techniques. *Post-mortem* examination, followed by laboratory examination for immature worms was the only means of confirming a clinical diagnosis.

The reference to aerosol therapy in parasitic bronchitis was made in the paper for the sake of completeness, rather than as a recommendation that it should be adopted. The aerosol therapy referred to was developed by Enigk in Germany who used an air compressor to force air over atomisers containing anthelmintic. The aerosol passed by means of tubes from the atomisers to face masks applied to the animals to be treated. Enigk used a variety of anthelmintics but concluded that an ascaridol-santonin mixture was the best.

Dr. Soulsby had replied very efficiently to Mr. White's point on host-parasite relationships, but in passing Dr. Gibson pointed out that epidemiological work on parasitic diseases provided information which enabled one to make the best use of vaccines, anthelmintics or of any other preventive measures which may be devised. In reply to Mr. White's other question, sodium fluoride given as a 1.5 per cent. mixture in the food was the best treatment yet devised for *Hyostrongylus rubidus* and was reported to be 80 per cent. or more efficient in most cases.

He was aware of the anthelmintic properties of the compound M.K-360 mentioned by Mr. Leiper, but had not yet had an opportunity of reading the paper by Hebden which had been published in Australia, and on that account had not mentioned the compound in the opening remarks. He agreed with Mr. Leiper that the piperazine compounds were efficient against *Oesophagostomum* spp. in sheep.

Mr. Olivant raised the thorny problem of toxicity of carbon tetrachloride upon which a good deal of work had been done recently in Australia. It was a very difficult problem for it seemed to be quite impossible to produce in the laboratory the type of toxicity usually seen in the field following the administration of carbon tetrachloride. Mr. Olivant's suggestion was interesting but apart from the work to which he referred there was no evidence that prevention of toxicity could be achieved in practice.

Mr. Daly's comments on the treatment of fascioliasis were sound. Farmers who would not allow the administration of carbon tetrachloride orally were prepared to use the intramuscular injection in pregnant ewes. Mr. Daly's method of treating tapeworms and parasitic gastro-enteritis in sheep would be expected to be followed by the excellent results he claimed.

Mr. J. B. White proposed a vote of thanks to the speakers. Parasitology in the last few years, he said, had made most exciting strides. There was no field which had made such developments and which held such promise for the future as the science of parasitology since the last war, and it is essential that the progress should be continued if those concerned were to make full use of the increased productivity from grassland being offered at the present time. After a visit to Hurley one was brought to realise how far developments were already proceeding, and the possibilities which lay ahead in the production of grassland were immense. If full use were to be made of them it was necessary to learn to cope with the parasite problem.

The Committee could not have chosen better speakers for the main papers. Dr. Gibson and Dr. Soulsby had been leading in this particular field for many years, and as a practitioner he knew how very helpful they were to those in practice. He had approached them on various occasions and had always received the greatest assistance. The Committee also made an excellent choice in selecting Mr. Pasfield as the opener of the discussion. Sussex was a part of the world where parasitology had always been a great problem, and Mr. Pasfield had dealt with the subject very thoroughly indeed.

The vote of thanks was carried by acclamation.

INTERNATIONAL TRANSIT OF ANIMALS

In the House of Commons on October 23rd Sir B. Janner asked the Lord Privy Seal whether he is aware that there is no law which ensures the punishment of persons who have exported animals under such conditions that they can be eaten by maggots and suffer other forms of ill-treatment; and if he will seek international agreement to remedy the position.

The Minister of State for Foreign Affairs (Mr. Joseph Godber): "The 1911 Protection of Animals Act provides certain safeguards in so far as British nationals and British ships are concerned. In the international field, the Consultative Assembly of the Council of Europe last month adopted a recommendation advocating the drafting of a Convention on the International Transit of Animals. Her Majesty's Government are now considering their attitude to this recommendation."

The Use of Oxytetracycline* in the Prevention of Neonatal Scouring in Piglets

BY

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Blandford Forum, Dorset

Introduction

NEONATAL scouring and deaths in young piglets due to *Escherichia coli* infection had become a major problem on several farms in this practice when it was decided to try the effect of injecting the sow at the time of parturition with 1 gramme of oxytetracycline. On one farm the owner agreed to allow us to carry out a controlled experiment, treating half the sows and leaving the rest untreated. This was started in January, 1961.

The farrowing house on this farm consists of 8 pens contained in a single house. The dividing partitions are of heavy gauge wire mesh, and access to all the pens is from a passageway running the whole length of one side of the building. Each pen is equipped with creep and infra-red lamp. The house has a false ceiling and an extractor fan at each end.

Drainage is towards the passage and it is possible for a certain amount of faeces and urine to pass from pen to pen through and under the wire mesh partitions. It is also possible for faecal material and urine to be conveyed from pen to pen by contamination of the footwear of persons using the passage.

Disease Position Prior to the Start of the Experiment

Prior to the start of this experiment there had been severe losses due to neonatal scouring and septicaemia. *E. coli* was suspected as being the causal organism, and of several piglets sent for examination to the Veterinary Investigation Centre, Langford, all were reported to have been suffering from an *E. coli* septicaemia.

The piglets appeared normal at birth and then commenced scouring at about 48 to 72 hours (occasionally the onset of symptoms would be delayed until the piglet was about 1 week old). They then suffered a rapid wasting and died within 24 to 48 hours. Practically every litter was being affected, and the owner estimated that his losses due to this condition were approximately 20 to 30 per cent. of piglets born.

There was no other disease problem.

The sows were all Wessex Saddlebacks and they run with Large White boars in large paddocks until about 1 to 2 weeks before farrowing, when they came into the farrowing house.

Results

It was decided that as the sows farrowed, half would be treated and half left as controls. It was intended that if possible the sows would be injected with 1 gramme (20 c.c.) oxytetracycline solution immediately prior to farrowing, but in practice the owner found it difficult to predict to within a few hours when they would commence and so in most cases the injection was given within a few hours of parturition.

Deaths attributed to *E. coli* during the experiment were diagnosed on symptoms and not on laboratory examination, with the exception of 2 piglets which were sent to the Veterinary Investigation Centre on March 24th. The report on these piglets indicated *E. coli* as the causal agent.

A. **Pen 6.**
Farrowed January 3rd, 1961.
10 piglets born.
Sow killed 4 soon after farrowing.
4 piglets died January 4th—January 6th from *E. coli* infection.
2 piglets reared successfully.

B. **Pen 2.**
Farrowed January 8th, 1961. Injected with 20 c.c. oxytetracycline January 8th, 1961.
10 piglets born.
1 dead in cleansing.
1 overlaid during farrowing.
1 died January 10th from *E. coli* infection.
7 piglets reared successfully.

C. **Pen 8.**
Farrowed January 8th, 1961. Injected with 20 c.c. oxytetracycline January 8th, 1961.
14 piglets born.
1 dead in cleansing.
1 so weak at birth that owner destroyed it.
12 piglets reared successfully.

D. **Pen 4.**
Farrowed January 10th to 11th, 1961.
8 piglets born.
1 trapped under water trough and died.
1 died January 14th, 1 died January 15th and 1 died January 17th from *E. coli* infection.
4 piglets reared successfully.

E. **Pens 5 and 6a.**
Pen 5 Farrowed January 23rd to 24th, 1961.
3 piglets born
Pen 6a Farrowed January 23rd to 24th, 1961. Sow injected with 20 c.c. oxytetracycline January 24th.
4 piglets born.
Litter from 5 added to litter in 6a.
1 piglet died February 2nd following a deep cut across the loin.
6 piglets reared successfully.

F. **Pen 1.**
Farrowed February 25th. Injected with 20 c.c. oxytetracycline February 26th.
15 piglets born
4 piglets born dead.
3 piglets overlaid by sow.
8 piglets reared successfully.

*Terramycin Injectable Solution 50 mg. per ml. Pfizer Ltd.

G. **Pen 5a.**
Farrowed January 29th to 30th, 1961.
6 piglets born and reared successfully.

H. **Pen 7.**
Farrowed February 12th, 1961.
13 piglets born
1 piglet died February 15th from *E. coli* infection.
12 piglets reared successfully.

I. **Pen 3.**
Farrowed February 13th to 14th, 1961. Injected with 20 c.c. oxytetracycline February 14th, 1961.
10 piglets born.
1 piglet died February 5th after a long period of gradual wasting. This piglet was suckling on a teat with very little milk. It remained alert and lively until the end. There was no evidence of scouring at all.
9 piglets reared successfully.

J. **Pen 2.**
Farrowed February 1st, 1961
11 piglets born.
4 overlaid at farrowing.
2 overlaid February 2nd.
1 died February 7th from *E. coli* infection.
4 piglets reared successfully.

L. **Pen 4.**
Farrowed March 6th, 1961.
6 piglets born and reared successfully.

M. **Pen 6.**
Farrowed March 7th to 8th, 1961. Injected with 20 c.c. oxytetracycline March 8th.
10 piglets born.
1 very weak at birth.
Very weak piglet killed by owner March 9th.
1 piglet died due to atresia ani March 22nd.
8 piglets reared successfully.

N. **Pen 5.**
Farrowed March 22nd, 1961.
9 piglets born.
4 piglets died March 24th due to *E. coli* infection (Lab. confirmed).
5 piglets reared successfully.

O. **Pen 2.**
Farrowed March 23rd, 1961. Injected with 20 c.c. oxytetracycline March 23rd.
12 piglets born. 2 very small indeed.
1 of the very small piglets died March 24th.
11 piglets reared successfully.

P. **Pen 1.**
Farrowed 23rd March, 1961.
9 piglets born. 1 crawled through a gap into the drain and drowned.
8 piglets reared successfully.

Q. **Pen 9.**
Farrowed March 24th, 1961. Injected with 20 c.c. oxytetracycline March 24th.
10 piglets born
1 born dead.
9 piglets reared successfully.

R. **Pen 3.**
Farrowed April 3rd to 4th, 1961. Injected with 20 c.c. oxytetracycline April 4th.
8 piglets born and reared successfully.

S. **Pen 7.**
Farrowed April 6th, 1961. Injected with 20 c.c. oxytetracycline April 6th.
7 piglets born.
1 piglet overlaid April 9th.
6 piglets reared successfully.

T. **Pen 4.**
Farrowed April 24th, 1961.
10 piglets born.
1 overlaid April 25th,
April 26th 2 piglets died from *E. coli* infection and all remainder showing signs of *E. coli* scour.
7 piglets injected with ¾ c.c. oxytetracycline each,
7 piglets all recovered.
7 piglets reared successfully.

The following 4 litters are not included in the percentage losses as all the sows were injected with oxytetracycline and none left as controls.

U. **Pen 5.**
Farrowed May 16th, 1961. Injected with 20 c.c. oxytetracycline May 16th.
8 piglets born.
1 piglet overlaid May 19th
1 piglet destroyed—atresia ani May 22nd.

V. **Pen 1.**
Farrowed May 17th. Injected with 20 c.c. oxytetracyline May 17th.
11 piglets born.
1 piglet overlaid May 18th.

W. **Pen 8.**
Farrowed May 17th, 1961. Injected with 20 c.c. oxytetracycline May 17th.
7 piglets born.
1 overlaid May 19th.

X. **Pen 6.**
Farrowed May 18th, 1961. Injected with oxytetracycline May 18th.
11 piglets born.

The accompanying notes and Tables I and II illustrate the results of the experiment. As can be seen, deaths due to *E. coli* infection were significantly reduced in the piglets from the group of sows injected with oxytetracycline. Unfortunately, as it became apparent that deaths from *E. coli* were reduced after injection of the sows, it became increasingly more difficult to persuade the owner to leave sows untreated. After the end of April he wanted all sows injected and the next 4 sows to be injected are recorded in the tables, but are not included in the percentage losses.

In one untreated litter (Ref. T.) all the piglets except 2 began to show signs of *E. coli* scour. After 2 piglets had died, the owner wanted all the piglets treated. These were accordingly injected with ¾ c.c. oxytetracycline each and all recovered.

Discussion

It would appear from the limited number of sows used in this experiment that the injection into the sow of 1 g. oxytetracycline at the time of parturition offers a useful and practical method of control of neonatal scouring and septicaemia in piglets due to *E. coli* infection. In view of the piglets treated from Ref. T. it would also seem that injection of oxytetracycline to affected piglets will effect a cure.

It will be seen that the mortality due to *E. coli* infection, in piglets produced by untreated sows, is less (18·29 per cent.) than the mortality (estimated by the owner) prior to the commencement of the experiment (20 to 30 per cent.). This may be just a coincidence, but it is possible that the treatment of half

TABLE I

RECORD OF LITTERS FROM SOWS INJECTED WITH OXYTETRACYCLINE

Reference number	Pen number	Date farrowed	Number born	Date injected	Deaths due to *E. coli*	Deaths due to other causes	Remarks
B	2	8.1.61	10	8.1.61	1	2	
C	8	8.1.61	14	8.1.61		2	
E	5	23–24.1.61	3	24.1.61		1	Both litters put together.
	6a	23–24.1.61	4	24.1.61			
F	1	25.1.61	15	26.1.61		7	
I	3	13–14.2.61	10	14.2.61		1	
K	8	6.3.61	10	6.3.61		2	
M	6	7–8.3.61	10	8.3.61		2	
O	2	23.3.61	12	23.3.61		1	
Q	9	24.3.61	10	24.3.61		1	
R	3	3–4.4.61	8	4.4.61			
S	7	6.4.61	7	6.4.61		1	
Totals			113		1	19	
% losses					0·88%	16·8%	
U	5	16.5.61	8	16.5.61	0	2	
V	1	17.5.61	11	17.5.61	0	1	
W	8	17.5.61	7	17.5.61	0	1	
X	6	18.5.61	11	18.5.61	0	0	
Totals					0	4	

TABLE II

RECORD OF LITTERS FROM SOWS NOT INJECTED WITH OXYTETRACYCLINE

Reference number	Pen number	Date farrowed	Number born	Deaths due to *E. coli*	Deaths due to other causes	Remarks
A	6	3.1.61	10	4	4	
D	4	10–11.1.61	8	3	1	
G	5a	29–30.1.61	6			
H	7	12.2.61	13	1		
J	2	1.3.61	11	1	6	
L	4	6.3.61	6			
N	5	22.3.61	9	4		Laboratory confirmation on 2 dead piglets.
P	1	23.3.61	9		1	
T	4	24.4.61	10	2	1	All piglets showed signs of *E. coli* scour and injected with Oxytetracycline
Totals			82	15	13	
% losses				18·29	15·85	

the number of sows resulted in a general reduction in the numbers of bacteria and/or in the virulence of these.

A further method of control which might be given a trial would be the injection of all the piglets at an early age, say, 24 to 36 hours of age. If this method was successful then it would create quite a considerable saving in oxytetracycline.

The method of treatment by injection of the sow has also been used on several other farms in this practice, but without controls being kept. In all cases the incidence of scouring in the piglets has been very markedly reduced.

Acknowledgment.—We should like to thank Pfizer Ltd., Folkestone, Kent, for supplying the Terramycin used and for their help in preparing this article.

BEEF RESEARCH PROJECT

The Royal Smithfield Club and the Agricultural Research Council are jointly financing a project in beef production using pure-bred Herefords and Friesians and Hereford-Friesian crosses. This project is due to commence next month.

The project aims to establish, among other things, the stages of growth at which the development of various parts of the beast takes place with a view to obtaining information which will help feeders in the management of beef cattle and enable them to produce the highest possible proportion of valuable meat in each carcase. It is not anticipated that any figures will be published for general information until the project has been completed.

Intraperitoneal Medication of Cattle, Pigs and Mink

BY

OLAF SWARBRICK

Arundel, Sussex

SUMMARY.—This technique is easy and straightforward and the possibilities of untoward accidents are remote. It is a very useful means of dosing cattle with drugs which require large volumes of solution or cause pain when given intramuscularly or subcutaneously, and it eliminates the necessity for effective restraint.

Introduction

STRATTON (1957) appears to have been the first to draw attention to the value of intraperitoneal medication in cattle, although this route has been used for the administration of anaesthetic solutions to small animals for many years. He suggested this route for the administration of soluble sulphadimidine, pointing out that it was also suitable for glucose and saline solutions, and advised that irritant solutions should not be given. Swarbrick (1961) enlarged on this by suggesting that it was a very convenient means of administering diethylcarbamazine solution*, and that untoward side effects had not been observed although this solution is somewhat irritant (Parker & Vallely, 1960). This note is an account of the writer's technique and the uses to which he has put it in practice.

Technique

Stratton (*loc. cit.*) stresses the necessity for clipping the hair and suitably cleansing the skin at the proposed site of the injection, but this adds considerably to the time involved, particularly when dosing a large number of animals.

The site used is the right sublumbar fossa, about mid-way between the posterior rib and the angle of the ileum, and some 6 inches or so below the lateral border of the lumbar transverse processes. A 13-gauge 2-inch needle is used, and this is driven very hard at right angles to the skin into the flank so that it penetrates the skin, muscle and peritoneum in one movement to its final position. The operator should then take one smart step backwards before the cow reacts! The needle should now be in the peritoneal cavity and slight movement of the head of the needle will usually result in the movement of air into or out of the peritoneal cavity, serving to confirm that the tip is not still embedded in muscle or fat. If done gently this movement is rarely resented. A syringe or flutter valve tube may now be connected to the needle, and the required volume of solution run in. Although it is obviously preferable to use a warmed solution the injection of solution at the prevailing ambient temperature appears to have caused no ill effects, except perhaps in pigs, even when up to 1,000 ml. have been given. Stratton (*loc. cit.*) suggests that the injection be made into the left sublumbar fossa taking care to avoid penetrating the rumen, but this latter has been found difficult. A neighbouring colleague also uses the left sublumbar fossa but attempts to place the injection as close to the angle of the ileum as possible and thus to penetrate the peritoneum posterior to the rumen (Metivier, 1961).

Piglets are held upside down by the hind legs with the ventral abdomen facing the operator. The injection can be made into the inguinal region to one side of the mid-line and anterior to the inguinal canal. In suckling piglets a needle 1 mm. in diameter and 1 to 1.5 cm. long is used. It is thrust in at right angles to the skin, the operator having to judge how far it may safely be inserted. Mink are also injected in the posterior abdominal region, using a similar needle as for piglets. Kits, which may be held in a gloved hand, can be stretched out so that the abdominal wall is taut and the needle inserted for what appears to be the correct distance into the lateral inguinal region. Vicious females and large males are restrained in a "squeeze-cage" (made of wire mesh with a movable false floor so arranged that the imprisoned animal can be literally spread-eagled against the roof). This should enable the operator to try to inject it somewhere in the correct region without getting any fingers bitten.

Side Effects

Side effects from both the actual technique used and the administration of various drugs by this route have been almost non-existent. One 6-month-old Hereford calf died 2 hours after the injection of soluble sulphadimidine. *Post-mortem* examination showed severe haemorrhage and oedema of the tissues in the centre of the right kidney. The injection had been made too high up in the flank, and the needle penetrated the right kidney which lies somewhat ventrally below the roof of the abdominal cavity. Since then care has been taken in young cattle to place the injection sufficiently low in the sublumbar fossa to avoid a recurrence. The attempted administration of 0.9 per cent. saline intraperitoneally to weaner pigs with enteritis, and dehydration was invariably followed by death and consequently not many have been so treated. It was not apparent whether this was due to the shock of the cold solution (hot water for warming the injection being rarely available in piggeries) or because it was administered to pigs which were already severely ill and likely to die. The impression gained at the time was that the pigs died as a result of the injection. Stratton mentions the possibility of damaging the small intestine when injections are made in the right flank, but no case of this appears to have occurred. The writer has always felt that

* Franocide, Burroughs Wellcome & Co.

the extreme mobility of the bowel would be likely to preclude such an accident.

Discussion

The intraperitoneal administration of a variety of drugs has been widely used by the writer over the last 3 years. The chief advantage has been the ease with which large volumes of solution could be administered without the necessity of the effective restraint required for intravenous injection. Intraperitoneal injections can usually be done with no more restraint than having the animal tied in her stall, and rarely is it necessary to have the head held, or the tail lifted. This lack of restraint is particularly valuable with nervous or timid animals, and those which are difficult to catch by the nose, and it enables the veterinary surgeon to dose animals without the assistance of the stockman. There is of course some pain associated with the penetration of the needle through the skin, the musculature and the perineum, but once the needle has properly penetrated the peritoneum no more pain appears to be felt by the animal, which stands quietly, allowing any volume of solution to be administered.

The technique has been found particularly valuable for the administration of calcium borogluconate solution to cattle in the early stages of milk fever, where they are still standing, but are inco-ordinate and may violently resist being held sufficiently still for intravenous injection. These animals can usually be quietly approached and the needle inserted before the animal has time to react. Once this has been done the injection can proceed in spite of staggering around the loose-box or other movement, and there is none of the difficulty associated with maintaining the needle in the jugular vein on these occasions. Both 20 per cent. and 40 per cent. solutions of calcium borogluconate as well as combined solutions of calcium, magnesium and phosphorus have been administered in this way. Magnesium sulphate has frequently been administered by this route for the treatment of hypomagnesaemia. This obviates the disadvantage of abscess or slough formation when the chemical is given subcutaneously, and the risk of cardiac collapse when given intravenously. Repeated injections of magnesium sulphate over several days have been given without ill effect for the treatment of the occasional "chronic" case of hypomagnesaemia seen in this area. Sodium iodide has been regularly given by this route for the treatment of actinomycosis and actinobacillosis. James (1951) records the intraperitoneal use of sodium iodide in poultry. In addition to the administration of diethylcarbamazine citrate,* Swarbrick (*loc. cit.*) methyridine† solution has also been administered by this route. As pointed out by Groves (1961) and Walley (1961) the subcutaneous administration of this latter drug causes considerable oedema and swelling which can be sufficiently severe to cause temporary lameness. This drug appears to be well tolerated intraperitoneally without any sign of peritoneal irritation, even after the administration of full doses, and there was no clinical diminution in its anthelmintic effectiveness.

One Friesian calf about 3 months of age was given 3 g. of calcium versenate‡ for suspected lead poisoning. The dose was diluted to give 5 per cent. solution used by Lewis and Meikle (1958) for intravenous injection, and was injected into the peritoneal cavity easily and painlessly. No clinical side effects were observed and when the calf was destroyed 24 hours later with the typical symptoms of opisthotonos and blindness associated with cerebro-cortical necrosis no sign of peritoneal irritation was found. This drug has previously been given by slow intravenous injection as subcutaneous dosage is excessively painful (Lewis & Meikle, 1958).

Various antibiotics have been administered by this route in conjunction with more conventional parenteral therapy for the treatment of acute peritonitis, particularly where this has been associated with metritis in parturient cattle. Clinically it would appear that the injection of the antibiotic directly into the peritoneal cavity should be helpful in these cases, but it was not found that there was a material improvement in the recovery rate. Stratton (*loc. cit.*) mentions the administration of glucose by this route, and this is now the usual method here of administering glucose for the treatment of acetonaemia. Glucose solution is also administered intraperitoneally to suckling pigs as supportive therapy if indicated in the management of parturient agalactiae in the sow, or scouring in the piglets. Soluble sulphadimidine is also given by this route to both cattle and pigs. This technique was found to be the easiest and most practical for the administration of distemper vaccine to mink. The technique has not been used on horses, sheep or goats.

* Promintic, I.C.I. Ltd.
† Riker Laboratories, Loughborough.

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BOOTS RESEARCH SCHOLARSHIP

The R.C.V.S. Trust has selected Mr. Peter Bernard English, M.V.SC. (Queensland), as Boots Research Scholar. The subject of his research, which will be undertaken in the Department of Veterinary Clinical Studies of the University of Cambridge, is *Water and Electrolyte Metabolism in Sheep and Calves.*

Mr. English, Senior Lecturer in Veterinary Medicine at the University of Queensland, graduated B.V.Sc. in that University in 1950 and obtained the Master's Degree in 1960, his thesis being entitled, *The Relationship between Dose Rate and Serum Concentration in Antibiotic Therapy, with particular Reference to Veterinary Therapeutics.*

Bone Marrow Biopsy from the Femur of the Dog

BY

JANE P. C. SPRANGER and J. M. HIME

Animal Health Trust, Canine Health Centre, Kennett, Nr. Newmarket, Suffolk

SUMMARY.—A method is described of obtaining specimens of bone marrow in the living dog without detriment to the health of the subject. This method entails the entry of the femoral medullary cavity by penetration of the bone in the floor of the trochanteric fossa, as for intra-medullary pinning.

Introduction

NUMEROUS methods have been described for bone marrow biopsy in laboratory and other animals. The sternum, ribs, and iliac crest have been used in larger animals and man, but are not practicable in smaller animals such as small dogs, cats, or laboratory animals, as the sites are correspondingly small. There is also the risk of penetrating the thorax in the first 2 methods. Meyer and Bloom (1943) reported the successful use of the iliac crest site in 10 dogs of various breeds and ages, but did not mention whether any of these were very small, or puppies. We have found that the iliac crest of the old dog can be very hard, and there is considerable danger of the needle slipping off it under the pressure required, and causing unnecessary trauma.

Sundberg and Hodgson (1949) reviewed methods in use before 1949. These methods were cumbersome, and usually involved drilling the bones in question through a surgical wound. Sundberg and Hodgson, and Volta (1952) described techniques for tibial marrow biopsy from the proximal end of the tibia. Erf (1937) described a technique for aspiration of marrow *via* a needle passed into a previously bored hole. A method involving entry of tibial or femoral medullary cavity *via* the femoro-tibial joint is described by d'Agostino (1949). This is considered to be unjustifiably hazardous in the clinical case. Most of these methods are unsuitable for routine clinical use. With the exception of d'Agostino's method, the samples are all taken from areas of cancellous bone. The method described below of extracting marrow from the middle third of the medullary cavity, yields specimens less likely to contain spicules of bone.

Method

The femur was first measured so that an instrument of appropriate length could be chosen. For small puppies a needle of 1.0 m.m.o.d., 3.5 cm. long, and for adult dogs, one of 2.0 m.m.o.d., 9.0 cm. long, both fitted with a stilette, were used. Aseptic precautions were observed throughout. The animal was placed on its side, the biopsy being taken from the uppermost leg. The anatomical landmarks used were the same as those for insertion of an intramedullary pin, as shown in Figs. 1 and 2.

Two methods of anaesthesia were used according to the age and temperament of the subject. Puppies, one of which was submitted to biopsy at 1 day old, were anaesthetised with halothane alone on open circuit. In adult dogs local infiltration anaesthesia in the trochanteric fossa was used.

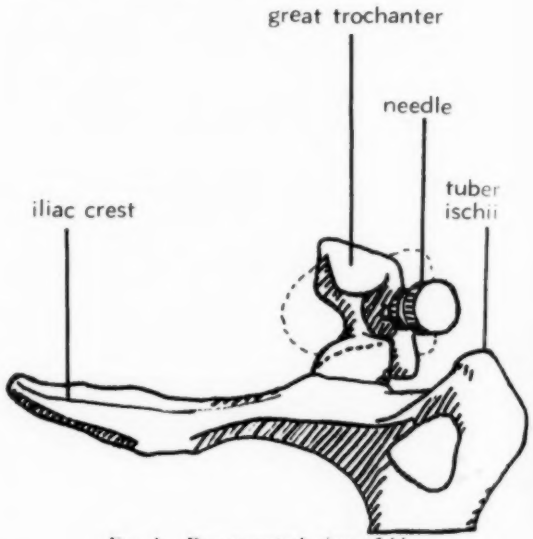

FIG. 1.—Dorso-ventral view of hip.

When the anaesthesia was found to be satisfactory, the needle was introduced through the skin, midway between the head of the femur and the great trochanter. The point of the needle was directed towards the great trochanter in order to avoid the possibility of penetrating the sciatic nerve. The needle was then steered into the fossa, and by gentle screwing, pushed through the bone. Care was taken to make sure that the needle was well trapped within the fossa, as it might otherwise have travelled down the outside of the bone and caused periosteal damage. As soon as the bone was thought to have been penetrated, the protruding length of needle was moved to and fro antero-posteriorly: the femur moved in a reciprocal manner if the bone had indeed been penetrated. The needle was then inserted up to the predetermined level, so that the point lay within the middle third of the shaft of the femur. It was found necessary to align the needle carefully with the longitudinal axis of the bone, otherwise penetration or even perforation of the diaphyseal cortex might occur. If no marrow could be withdrawn, this accident was suspected and the needle repositioned. The

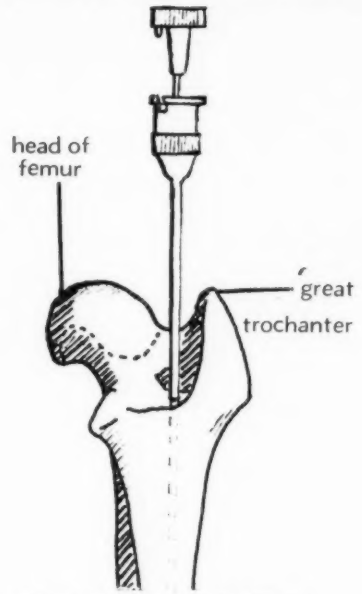

FIG. 2.—Lateral view of femur.

stilette was then removed, and a 10- or 20-ml. all-glass syringe, lubricated with liquid paraffin, was connected to the needle. Marrow was aspirated by a sharp withdrawal of the plunger to approximately two-thirds of its full extent. A maximum of ½ ml. of marrow was removed to avoid dilution with blood; when this amount had been collected, the negative pressure in the syringe was released gently. Whenever possible, smears were made immediately. Otherwise the sample was expressed at once into a bottle containing sequestrene prepared for 3 ml. of blood. Smears from sequestrenated samples had to be made within 30 minutes to avoid morphological change of the cellular elements. After collection of the sample, the needle was removed without reinserting the stilette since this might introduce infection.

Finally a little streptomycin and penicillin cerate was introduced through the skin wound. Neither haemorrhage from the skin wounds, nor post-operative complications occurred in our cases.

The method has been used in the course of studies of the bone marrow in 4 adult dogs and 3 Beagle puppies. One of the puppies had 5 biopsies taken at weekly intervals, starting when it was 1 day old. The other 2 had 3 biopsies at weekly intervals starting when they were 8 days old. All 3 had a further biopsy at 9 weeks of age. It is suggested that this method might have some application both as a routine biopsy method for clinical use in small animals and also for bone marrow studies in laboratory animals.

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Arsenic Poisoning in Turkey Poults

BY

J. F. HARBOURNE

Veterinary Investigation Centre, Leeds

A GROUP of 1,200 broad-breasted white turkey poults was introduced to one end of a dutch barn when they were 6 weeks old. Litter consisted of oat straw which had been laid over a permanent bed of cinders. The birds were fed on proprietary turkey pellets, which contained neither antibiotics nor blackhead prophylactics. Self feed hoppers were employed, and water was supplied through the mains by automatic flow.

One month before the turkey poults were placed in their new quarters 2 dogs died on the premises from arsenical poisoning, 1 of which was seen to vomit over part of the cinder bed subsequently occupied by the birds. Two weeks later 20 sheep were treated for foot-rot in the same building. Each animal was walked through a bath containing 1 quart of an arsenical preparation to 20 gallons of water. According to the makers there was 56 per cent. of arsenious trioxide (W/V) in the undiluted suspension.

Course of the Illness

Three weeks after the turkey flock had been introduced to the dutch barn one bird died after an illness lasting 2 hours. The next day another bird was found dead and within a further 72 hours 7 had died and 14 were ailing. Affected birds sat about in attitudes of extreme dejection with no desire to move from their crouched positions. All were affected with diarrhoea and their vent feathers were stained with a yellow watery discharge. These symptoms were followed either by death in 2 to 3 hours or by a slow and uneventful recovery. The remainder of the flock appeared healthy although there was an overall drop in food consumption and an increased thirst, which roughly coincided with the period between the first and last death. In an effort to minimise the losses and before a firm diagnosis was made, molasses and oxytetracycline at a curative level were added to the drinking water for a period of 3 days.

Post-mortem Examinations

Seven of the dead birds were submitted to this Centre for *post-mortem* examination. The carcases were in good condition and with the exception of the kidneys which were swollen and congested and contained an excess of urates in the ureters, the lesions were confined to the gastro-intestinal tracts. In all cases there was an extremely severe haemorrhagic enteritis which extended along the whole length of the small intestine to the rectum. In addition there was a copius discharge of mucoid material into the lumen of the bowel. The gizzards were impacted with straw, which had a slightly sweetish smell, while the linings stripped off easily, revealing diffuse areas of ecchymoses in the submucosa. Similar haemorrhagic patches were observed in the mucous mem-

brane of the proventriculus of one of the birds. The crop contents varied. In some birds the organ was distended with mash, while in others it was empty except for a small quantity of straw or fluid. Because of the similarity of the pathological changes to those seen in cattle which have died from arsenic poisoning, portions of liver from 3 of the poults were sent to the Biochemistry Department of the Central Veterinary Laboratory, Weybridge. Chemical examination showed that the arsenic values were very high and indicated that there must have been a recent absorption of abnormal amounts of this poison.

Discussion

The evidence suggests that the most likely source of arsenic was the sheep foot-rot bath. The *post-mortem* findings were typical of acute arsenical poisoning but differed from those described by Garner (1957) and Wilson (1961), in which the main lesions seen in fowls were restricted to the proventriculus and gizzard of affected birds. In most respects the distribution of the lesions resembled the ones recorded by Hinshaw (1948) following the death of 5 per cent. of a flock of turkey poults after they had had access to poisoned grasshopper bait.

Acknowledgments.—I wish to thank Miss G. Lewis, B.Sc., for her kindness in conducting the necessary biochemical tests on the livers submitted to her.

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Clinical Note

Fracture of the Os Pedis in the Cow

A. R. Hopkins
Tiverton

THE recent "Symposium on Diseases of the Bovine Foot" (*Vet. Rec.* **72.** 1,212) prompts me to record 2 unusual cases of lameness in the cow. Fracture of the pedal bone would seem to be a rare occurrence in the cow, and only Dr. Arthur made brief reference to this condition in the aforementioned symposium.

On July 12th, 1960, I was asked to examine a Friesian cow which was lame in the left forefoot. The history was that this cow had been slightly lame in front for several weeks, and the condition had now worsened to the point where a left forefoot lameness was obvious. The foot was of perfect conformation, the horn sound in every respect, but there was definite pain on percussion of the sole of the inner claw, and the animal walked showing such a marked tendency to take weight on the outer claw alone that it regularly crossed the left leg in front of the right with each stride. A tentative diagnosis of pedal arthritis due to deep-seated infection following a punctured sole was made. This seemed a reasonable suggestion since the symptoms were similar to those previously observed in a case where punctured sole was known to have preceded a lameness developing some weeks after recovery from the former condition. No heat or swelling whatsoever was observed, and it was felt that the condition would soon either correct itself or develop more definite symptoms. For the present it seemed inadvisable to pare extensively the sole of an otherwise perfect foot. Analgesics were used in an endeavour to give some relief, but this was without success, and 2 weeks later the cow was re-examined.

The deterioration in the cow's bodily condition had been severe, and the milk yield had fallen seriously. She would scarcely move unless forced to, and when she did so it was obvious that any pressure on the inner claw of the left forefoot was unbearable, though she still tried to take weight on the outer claw. Percussion evinced severe pain, but there was still neither heat nor swelling and the horn was hard and sound. In view of the animal's distress and serious loss of flesh and milk it was decided to recourse to amputation of the affected claw.

Chloral hydrate was administered intravenously in the standing position until the animal was cast. She was then hobbled and the affected claw was completely anaesthetised using a "ring block" at mid-pastern level around the inner os suffraginis. Amputation was through the lower end of os suffraginis. It was here possible to leave an ample skin flap to be drawn over the lower end of the bone with 4 braided nylon sutures. Recovery was uneventful with rapid gain in flesh and milk yield. Healing was complete in 4 weeks. Dissection of the amputated claw revealed a fracture of the pedal bone.

On dissecting the amputated claw, a quantity of blood-stained synovia was observed to spurt from the coffin joint when this was incised. Further dissection revealed a complete transverse fracture of the os pedis almost in the middle of the articular surface. The articular cartilage at the fracture site had a thin, red, rather membraneous border, but there was no indication of osseous union. This might be expected since any weight applied to the pedal bone's articular surface would tend to separate the fragments. It was felt that the fracture could not have been present very long since the tissue reactions appeared to be recent. The bones seemed to be of normal hardness.

One is perplexed to explain how such a fracture might occur. In the hind limb it could be caused by the cow kicking out and striking a wall or similar object but this could scarcely occur with a forefoot.

In December this cow, only a week before calving, suffered an acute attack of laminitis affecting the forefeet only. This quickly responded to antihistamine therapy and was thought to be quite unrelated to the pedal fracture. A previous attack of laminitis may have accounted for the stockman's reference to the cow's tended-footed gait for several weeks prior to the onset of lameness in the left front foot. The pottering gait persists to this day.

No. 36 Little St. Martin's Street, Leicester Square

BY

L. P. PUGH

IF you walk a short way down St. Martin's Street from the south side of Leicester Square, you will come to a small turning on your left into Orange Street.

On the corner you will find a comparatively new building—the Central Reference Library of the City of Westminster. Inside the front entrance you will see a plaque which reads:—

"Here stood the house of Sir Isaac Newton in which he lived from 1710-1727 and was visited by his friends Addison, Burnet, Halley, Swift, Wren, and other great men. Later it became the home of Dr. Charles Burney and his daughter Frances and was the resort of Johnson, Reynolds, Garrick and many others. The Library also covers the site of the Leicesterfields Chapel built for the Huguenots in 1693."

The Chapel, in fact, still stands. It was here that John Wesley's opponent, the Rev. Augustus Montague Toplady (who wrote "Rock of Ages") preached. But this note, historically interesting as it may be to some, should be even more so to members of the veterinary profession, because it was from Sir Isaac Newton's house that St. Bel published his *Plan for Establishing an Institution to Cultivate and Teach Veterinary Medicine*, in March, 1790. This was certainly the most important veterinary historical document to be printed in the 18th century and, in fact, up to 1844, since it laid down a definite plan not only for a veterinary school but also for the as yet unborn profession. St. Bel sent 10 copies of this 28-page booklet to the Odiham Agricultural Society and, as a direct consequence, he was elected an Honorary and Corresponding Member of that Society on October 8th of the same year. Unfortunately, the letters notifying him of his election went astray owing to the fact that he had been forced, on financial grounds, to leave his expensive residence in St. Martin's Street and live more frugally in the country. When, eventually, he learnt of his election he wrote immediately to Huntingford the secretary of the London Committee of the Odiham Society in the following terms:—

Wednesday Jan. 12th, 1791

Sir,

I beg the favour of you to inform the gentlemen of the Odiham Society, that I have but just been informed of the notice they were pleased to take of the letter, and plan, which I had the honour of conveying to them in the Summer; and that the letter they addressed to me in Leicester Square never reached me, on account of my having left that place, and being in the Country. They will be so candid as to ascribe to this, and to no other cause, my not acknowledging the honour they were pleased to confer upon me; and to believe that I shall be at all times happy to unite my labours to their exertions, in favour of Veterinary Medicine.

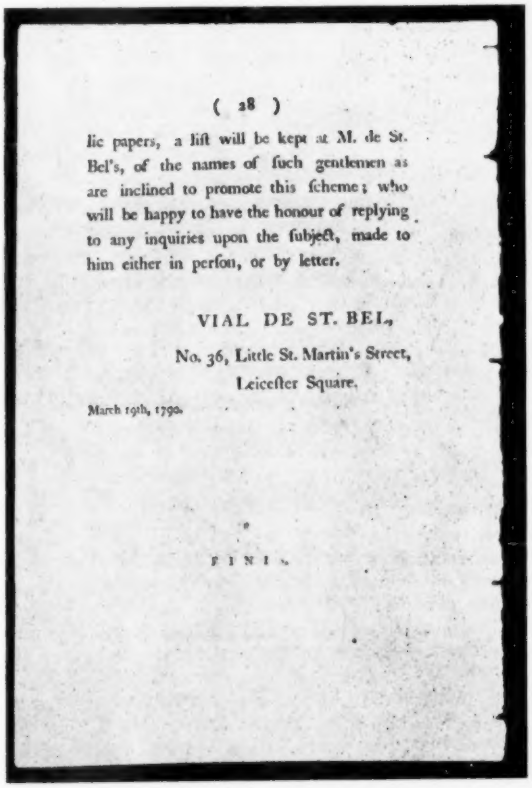
I have the Honour to remain, Sir,

Your Obed. & Humble Servant,

Vial De Saint Bel

Mr. Huntingford,
Secretary,
Odiham Society.

Although St. Bel signed this letter, he neither composed nor wrote it. There are reasons for thinking that his English wife helped him in this manner



(28)

lic papers, a liſt will be kept at M. de St. Bel's, of the names of ſuch gentlemen as are inclined to promote this ſcheme; who will be happy to have the honour of replying to any inquiries upon the ſubject, made to him either in perſon, or by letter.

VIAL DE ST. BEL,

No. 36, Little St. Martin's Street,
Leiceſter Square.

March 19th, 1790.

FINIS.

The last page of the St. Bel Plan.

whenever he wished to transmit a message officially to the Society, since he had the greatest difficulty with our language and even had to employ other people to translate his own lectures from French into English.

Current Literature

ABSTRACTS

Canicola Fever in Man from Contact with Infected Pigs. COGHLAN, JOYCE D., & NORVAL, JOHN (1960). *Brit. med. J.* December 10th, 1960. Pp. 1,711-13.

Outbreaks of human leptospirosis due to *Leptospira canicola* affecting workers on pig farms have been reported in Israel and in Edinburgh. That apparently normal pigs were harbouring the organisms and were probably responsible for the outbreaks in the Edinburgh farms was finally established by Coghlan, Norval and Seiler (1957) when they reported the isolation of *L. canicola* from specimens of urine collected from pigs at one of the farms where human cases had occurred.

The present report deals with cases that have occurred in the Edinburgh area subsequent to the publication of the paper in 1957. Of 16 cases of canicola fever, 11 were found to be among pig-farm contacts. Five farms were involved. A high percentage of the pigs at all of them were shown by serological tests to be probably actively infected.

L. canicola was isolated from the urine and kidneys of pigs at 1 of the 5 farms where the infection appeared to have been maintained for many years.

At 2 farms incriminated 5 years before in human outbreaks, 87 per cent. of sera of pigs were found to have antibody levels high enough to signify that active infection was still present in the herd.

These observations indicate that infection of a herd of pigs by *L. canicola* may be maintained for many years with risk of human cases resulting from contact with contaminated urine. This is especially apt to occur in young persons employed for the first time to work with pigs.

In an *addendum* it is reported that subsequent to the submission of this paper for publication 2 more cases of canicola fever have occurred in recently employed piggery workers.

Reference

COGHLAN, J. D., NORVAL, J., & SEILER, H. E. (1957). *Brit. med. J.* **1.** 257.

G. F. B.

The Metabolism of Specifically Labelled Glucose in Bovine Ketosis. TOMBROPOULOS, E. G., & KLEIBER, M. (1961). *Biochem. J.* **80.** 414.

Specifically labelled (1 ^{14}C) glucose and (6 ^{14}C) glucose were injected intravenously into ketotic cows and the results compared with those obtained previously with normal cows. The recovery of ^{14}C in respiratory CO_2, casein, albumen and citrate after (6 ^{14}C) glucose injection was less than the corresponding recovery in normal cows. This indicates either a decrease in ^{14}C transfer from glucose to respiratory CO_2 etc., or a relative increase in transfer of carbon atoms from other precursors or both. The results after (1 ^{14}C) glucose support these findings.

The recovery of ^{14}C in lactose and glycerol was the same in ketotic and normal cows after (6 ^{14}C) glucose injection but higher in ketotic cows after (1 ^{14}C) glucose injection.

Comparison of ^{14}C recovery in the different mild constituents after (1 ^{14}C) glucose and (6 ^{14}C) glucose injection shows a reduced participation of the hexose monophosphate oxidative pathway during ketosis. This seems to be correlated with impaired lipogenesis in ketotic cows.

The Physiological Rôle of the Ketone Bodies. (The Third Hopkins Memorial Lecture). KREBS, H. A. (1961). *Biochem J.* **80.** 225.

Liver does not use acetoacetate as a fuel but other tissues are shown not merely to use it, but to oxidize it in preference to glucose, so that acetoacetate, and especially β-hydroxybutyrate act as tissue nutrients alongside glucose and non-esterified fatty acids. It is, then, plausible to suppose that a mechanism exists to raise the level of ketone bodies when glucose is deficient as in starvation, or physiologically unavailable, as in diabetes.

Ready interconversion of acetoacetate and β-hydroxybutyrate occurs in tissues, this perhaps being a means of hydrogen transfer via DPN from substrates being oxidized. It may also be a means of hydrogen transfer from intramitochondrial to extramitochondrial sites in the cell.

The author suggests a metabolic interrelation in which most substrates being oxidized give their hydrogen to DPN, from which it is transferred either to acetoacetate or, via cytochrome, to oxygen. Succinate, on the other hand, gives its hydrogen directly to cytochrome so competing with DPNH for cytochrome. This competitive inhibition of the oxidation of DPNH causes a rise in DPNH concentration, and, in consequence, reduction of acetoacetate although the redoc potential of succinate reduction is much lower than that of DPNH reduction.

D. E. K.

Fascioliasis in Man: An Outbreak in Hampshire. FACEY, R. V., & MARSDEN, P. D. (1960). *Brit. med. J.* August 27th, 1960. Pp. 619-24.

During the autumn of 1958 in the Hampshire market town of Ringwood (population 7,000), several patients presented themselves with a mysterious illness characterised by pain in the right hypochondrium, and an irregular pyrexia lasting over 6 weeks. The most striking finding in each case was the presence of a marked eosinophilia. Some form of helminthiasis was naturally suspected and the symptoms suggested the possibility of infection with the liver fluke *Fasciola hepatica*. This theory was supported by the evidence of a veterinarian that the incidence of infection among local farm animals was very high.

Six cases are reported, in 5 of which the diagnosis was subsequently confirmed by the finding of ova of *F. hepatica* in the faeces. Several other cases with similar symptoms were seen, but were not included because the diagnostic evidence was not entirely conclusive.

It is probable that 3 aetiological factors combined

to cause this outbreak. The disease is endemic in the cattle in the Ringwood district of the Avon valley. There are a number of watercress beds nearby. The summer of 1958 was unusually wet. All the patients were in the habit of eating watercress grown in natural beds. A few hundred cases of human fascioliasis have been reported from various parts of the world. In all countries where human fascioliasis has been reported watercress has been found to be the usual vehicle. In 1959 watercress from a bed in a cow pasture was fed daily to 4 newly-weaned rabbits from June to October. The absence of any evidence of infection when the animals were killed in January 1960 may well have been due to the exceptionally dry summer of 1959.

Chloroquine sulphate was used in treatment and though it relieved the symptoms dramatically failed to cure.

G. F. B.

Antibiotics in Milk—A Review. ALBRIGHT, J. L., TUCKEY, S. L., & WOODS, G. T. (1961). *J. Dairy Sci.* **44.** 779.

The use of antibiotics in the treatment of mastitis has created many problems for the milk processor and consumer. Following the treatment of mastitis with antibiotics, these may be found in the milk in sufficient concentrations to inhibit dairy starter micro-organisms and cause economic losses to the cheese and fermented milk industries. Penicillin in very small concentrations found in milk may cause reactions in highly sensitive individuals.

In America 10 surveys covering a 9-year period in which 7,201 samples were tested found 377 (5.2 per cent.) to be positive for the presence of antibiotics. The American Dairy Science Association passed a resolution in 1951 that no milk obtained from a mastitis-treated quarter within 72 hours (6 milkings) after the last treatment with an antibiotic is to be marketed. However, it would appear that when moderate to high doses of antibiotics are administered in the form of 1 or more tubes per treatment, detectable amounts still occur 72 hours after treatment.

Data compiled on intramammary infusions, intramuscular injections and oral administration of antibiotics and their vehicles illustrate that wide variations exist concerning the relative persistence of the amount of antibiotic found in milk. In the case of udder infusions the length of time penicillin remains in the udder is directly influenced by its carrier. For example when 100,000 units of penicillin were incorporated into a combination of mineral oil, lanolin derivatives, water, propylene glycol and nonionic wetting agents, 0.014 to 4 units were present per millilitre 72 hours post treatment; but when cows were treated with propylene glycol, a nonionic wetting agent and 100,000 units of penicillin the concentration was zero after a lapse of 48 hours, while water plus 100,000 units of penicillin infused into the mammary gland showed no detectable quantities of penicillin 24 hours post treatment. It was also reported that procaine penicillin infused into the udder persisted 12 hours longer than did calcium penicillin.

Streptomycin has been reported in milk for as long as 72 hours following treatment. Chlortetracycline can persist in milk of treated cows for as long as 5 weeks, with considerable variation existing between cows in the amount of this antibiotic excreted.

Penicillin in the milk from animals treated intramuscularly with procaine penicillin G in oil (5,000 units/lb.) varied in concentration up to 96 hours with 0.01 unit/ml. penicillin present at that time. When cows were injected intramuscularly with an aqueous solution of penicillin there was a rapid build-up of penicillin in the milk to 0.135 unit/ml. 12 hours post treatment. By 96 hours there was less than 0.01 unit/ml. of penicillin in the milk.

The oral administration of a penicillin salt has been advised as a safeguard against bloat in cattle. No penicillin was found in the milk of cows receiving 86,700 units of penicillin per day; approximately 0.05 units of penicillin /ml. was found in the milk of cows receiving 178,400 units per day, and from 0.10 to 0.15 unit/ml. when 270,500 units per day were fed.

The persistence of antibiotics in milk differs from cows in early, mid, and late lactation, being highest near the middle and end of the lactation period and lowest during the full flow of milk.

Some recent studies using highly sensitive methods indicate that antibiotics are transferred from treated to untreated quarters, but with penicillin this transfer is slight and of short duration and not likely to present a problem.

Antibiotics in milk are relatively stable to pasteurisation temperatures and above, as well as to low temperatures (0-10°F.). Under refrigeration temperatures for up to 7 days of storage there tends to be a loss in antibiotic activity in both raw and pasteurised milk.

J. O. L. K.

Syndrome : "Maladie Des Chiens," résultats sérologiques constatations hématologiques. GROULADE, P. (1961). *Bull. L'acad. Vet. de France.* **161.** 4.

This article concerns serological and haematological observations on the canine distemper complex. Investigations have been carried out on dogs presenting clinical signs of the distemper syndrome from 1957 to 1960. Serological examinations for Carre's disease, Rubarth's and toxoplasmosis were undertaken on dogs varying from 154 to 250 in number. The most important conclusions are: (1) There were important variations in the respective percentages of these conditions in different years. (2) Mixed infections occurred. (3) Non-identified cases varied from 47 per cent. to 71 per cent.

Haematological results varied with the infections, and permitted the establishment of a diagnosis, and in certain cases indicated which virus was not the cause. The authors further consider that their haematological examination allowed them to distinguish mild disorders from those of infectious origin, thus avoiding the need for using antibiotic therapy, which in their view is at best useless, and in certain cases may be harmful.

C. F.

Divisional News

THE EASTERN COUNTIES VETERINARY SOCIETY

The summer and annual general meeting of the E.C.V.S. was held at King's Lynn on July 19th. Thirty-three people were present.

The prototype of a certificate of honorary membership of the Society was discussed.

The proposed method of reducing the size of Council B.V.A. was agreed to, with the provision of substitutes in the case of absenteeism. Subscriptions and donations were approved at the same rate as the previous year.

Col. Castle and Mr. W. Waters were unanimously elected Honorary Members of the Society. The hon. secretary in his report stated that membership of the Society stood at 152. This report, and that of the hon. treasurer were adopted.

Capt. J. C. Taylor was elected President for 1961/62 with Mr. G. E. Smith as Junior vice-President. The newly-elected members of the Executive Committee were: Dr. E. A. Gibson, Mr. W. W. C. Gibson, Mr. F. G. C. Lawfield and Mr. J. D. McLauchlan to serve for 3 years, and Mr. R. S. T. Bowden for 2 years.

Dr. A. J. Wilsdon was elected as representative to B.V.A. Council to serve for 2 years. After the year's programme had been discussed the retiring President, Dr. K. C. Sellers, gave his Presidential address and inducted the new President.

After lunch members were shown round the modern chemical plant of Messrs. Dow Agrochemicals by Mr. F. G. Brown, enjoyed tea, and moved on to the Swan Inn for the Shipley Bowls competition in which the wife of the retiring President, Mrs. R. Sellers, beat Mr. J. B. Spence to obtain the cup for the second year in succession.

THE MID-WEST VETERINARY ASSOCIATION

The summer meeting was held at the Avonmouth Mills of B.O.C.M. on July 14th, 1961. The President, Mr. J. Cameron, was in the chair. Twenty-one members were present. They were taken on a tour of the mills after having heard a short description of the stages of preparation leading up to the final product as sold to the farmer.

Tea was followed by a short business meeting, at which it was agreed that the minutes of the previous meeting should be read at the next general meeting.

The following were elected to membership: Professor T. K. Ewer, Langford, Mr. A. V. Clarke, Chew Stoke, and Mr. P. A. Mullen, Wedmore.

The following proposals from Council had been circulated, and were unanimously agreed by the meeting:

1. The clinical discussion group should hold 4 meetings a year.
2. That all members of the Mid-West Association should receive circulated information.
3. That—as far as possible—local speakers should address the discussion group.
4. That the Mid-West Association should pay for postage and the hire of the room for clinical discussion meetings.
5. That a sum of £10 should be provided by the Association annually, to the discussion group to defray the cost of speakers.
6. That subscription to the Mid-West Association would, automatically, make anyone a member of the clinical discussion group.

The business meeting was followed by a discussion on Some Aspects of Pig Nutrition. This was opened by Mr. G. W. Wilcock and Professor T. K. Ewer; and 8 members present contributed to the discussion.

A vote of thanks was proposed by the President to Mr. Wilcock and the members of the staff of B.O.C.M., who acted as guides on the tour through the mill.

THE SOUTH EASTERN VETERINARY ASSOCIATION

An ordinary general meeting was held at the Royal Star Hotel, Maidstone, on September 14th, 1961. The President, Mr. J. D. Paterson, took the chair, and in addition 18 members and 6 visitors signed the attendance register. Apologies for absence were received from Dr. Montgomerie and Mr. S. L. Hignett.

Minutes

The minutes of the last meeting, having been published in THE RECORD, were taken as read and confirmed.

Correspondence

Letters were received from the B.V.A. dealing with broken hypodermic needles in the flesh of food animals, and with representation of Divisions on the B.V.A. Council. The secretary was instructed to reply.

Election

Mr. Hugh Fraser, who had been nominated at the last meeting, was elected to membership.

Paper

Mr. J. D. Paterson, the President of the Association, who is V.I.O. at the Ministry's laboratory at Wye, gave a paper entitled "Observations on Some Diseases of Sheep."

The essayist pointed out that sheep husbandry formed a substantial part of farming activities in Kent, though the major part tended to be somewhat concentrated towards the eastern and southern parts of the county. Nevertheless, he felt that all members of the profession would be interested to a greater or lesser extent in the subject of his paper.

Mr. Paterson has, of course, practised for many years in Kent and has made a wide study of the various pathological conditions which afflict sheep in the county. His paper was a masterly précis of those diseases which he had found most important and prevalent, particularly those affecting the ewe and young lamb, starting with pregnancy toxaemia and continuing with other pre- and post-parturient con-

ditions, which are generally encountered up to weaning time.

The discussion was opened by Mr. Peyton, who commenced by thanking and congratulating the President on his paper, and a general discussion followed. Afterwards, the President was again thanked by Mr. Peyton, and the general applause of the members indicated their enjoyment.

Before closing the meeting the President reminded the members of the dinner which had been arranged for December 8th, and asked them to make arrangements to keep the date free.

NORTHERN RHODESIA VETERINARY ASSOCIATION

Precis of the Annual General Meeting held in Lusaka on May 13th and 14th, 1961, when 90 per cent. of the members were present

May 13th

Minutes

The minutes of the meeting of May 7th and 8th, 1960, were read and approved.

Matters Arising

Related to correspondence between the Association and various insurance companies that handled livestock insurance, and to the progress made in the matter of the Federal Veterinary Surgeons Bill. A précis of the fifth draft was given by the Director of Veterinary Services.

Election of New Members

The following new members were elected. Mr. R. Boyd, Mr. D. I. McKinlay, Mr. W. J. Nixon, and Mr. M. L. Wright. Dr. H. C. Theron's resignation was accepted with regret as he had left for the U.K.

Election of Officers

President, Mr. D. A. Hutchings; secretary, Mr. O. F. Jackson; committee, Mr. H. M. Scott, and Mr. T. T. McNaught.

Correspondence

The possibility of employment by the Government of veterinary surgeons whose qualifications were not recognised by the R.C.V.S. was discussed. The fact that the staff position was at present so acute that it might force the Department to reconsider their present attitude was mentioned, but it was suggested that no further decision should be made for at least 1 year.

The Trypanosome

It was agreed that the quarterly journal of the Association had been a great success.

Control of Unqualified Practitioners

The Director of Veterinary Services explained that until the Federal Veterinary Surgeons Bill was passed, little could be done because the "practice of veterinary surgery" was not well defined in the present ordinance.

Dinner

Thirty-three members, their wives and 4 guests dined at the Ridgeway Hotel. Sir John Moffat, Minister of Land and Natural Resources, proposed the toast to the Association.

May 14th

Surgical Demonstration

Mr. O. F. Jackson and Mr. M. L. Wright gave a short demonstration of ultra short acting anaesthesia (using rapid intravenous 1 per cent. Brietal Sodium), endotracheal intubation in the dog, the American sutureless stab spay technique in young puppies, and normal flank keyhole spay technique in the older bitch.

Tuberculosis

Mr. H. M. Scott opened a discussion on tuberculosis. He said that during the last year 8,000 head of cattle had been tuberculin tested in the Lusaka district. In the reactors from heavily infected herds up to 75 per cent. showed tubercular lesions *post mortem*. In herds with only 1 or 2 per cent. reactors, lesions were not often found, and it was thought that non-specific reactions occurred in association with "measles."

He gave the history of one particular herd of about 700 head that had been tested regularly over the past 4 years. The percentage of reactors had dropped slowly from 15 to 4 per cent. Forty animals which 3 months previously had been non-reactors were recently sent to Livingstone, and of these 11 (27 per cent.) showed TB lesions. At a test after this 23 per cent. gave either positive or inconclusive reactions, *i.e.* a major breakdown had occurred. The reason is unknown.

He believed that in Northern Rhodesia the pathology of bovine TB is different from that in the U.K. The lesions tend to be more caseous than calcified, indicating that the course of the disease is more rapid out here.

In the discussion that followed, the low plane of nutrition, the close contact with dust clouds of old faecal material during the long dry season, and the herding together of animals for dipping were all blamed for the differing epidemiology of TB in Northern Rhodesia.

Brucellosis

Colonel Ross opened a discussion on brucellosis. He questioned the efficiency of the milk ring test, giving the history of a herd to support this view.

In the discussion which followed, the fact that there was a 20 per cent. incidence of the disease in spite of a policy of vaccination with S.19 (Onderstepoort) was mentioned. It was noted that indiscriminate use of this vaccine interfered with the reading of blood titres, and a proposal was made that single calfhood vaccination only should be recommended. The press publicity given to the possibility of contracting undulant fever from milk was discussed at length.

Mr. McNaught

Mr. McNaught presented several canine problems to which he had given provisional names: gangrene of the tongue; eczematous lesions of the commissures of the lips and the end of the sheath; an eczematous condition of the scrotum seen particularly in Alsations; ophthalmia and purpura haemorrhagica.

The Ladies' Guild A.G.M.

The 30th Annual General Meeting of the Ladies' Guild was held on September 7th, 1961, in Rhodes House, Oxford. The President, Mrs. Jennings, was in the chair and 40 members signed the attendance book. Apologies for absence were received from Mrs. Locke, Mrs. Stobo and Mrs. Oliver.

The President warmly welcomed all the members present, and said she was sure everyone would wish a speedy recovery to Mrs. Locke from the accident which had prevented her from coming to the meeting.

Minutes

The minutes of the last Annual General Meeting were read, passed and signed.

Arising from the Minutes

The most important item in the minutes was that which concerned the rules. In accordance with the wishes of the members present at the last A.G.M. a committee was formed under the chairmanship of the President; it had met twice to discuss the rules, and now made the following recommendations:—

That the wording of Rule 3 be altered; that Rule 5 be deleted; and that a new rule be added.

Each member present had a copy of the existing rules. The alterations and addition were discussed. Mrs. A. J. Wright proposed that the recommendations of the committee be adopted, Mrs. Hebeler seconded and the motion was carried. It was noted with regret that Mrs. Beynon, wife of the President-elect of the B.V.A., had felt unable for family reasons to accept nomination as President of the Guild.

Correspondence

Three letters were read. Mrs. Glover wrote thanking all members for their gift of a cut-glass vase filled with flowers on her retirement as hon. treasurer. Lady Ritchie replied to a letter offering the Guild's congratulations when the honour of Knighthood was conferred upon her husband. The secretary of the B.V.A. wrote to thank the Ladies' Guild for all the help the Scottish members had given during the Congress week in Glasgow.

The President's Address

Mrs. Jennings thanked all those members who had elected her as President, saying that she regarded it as a great honour. She was pleased that during her year of office a new Division was being formed in Edinburgh. Mrs. Anderson of Stirling had invited her to speak to some Guild members, who had decided there and then to form a division. The word "Guild" meant an association for mutual aid; it is, by implication, founded in friendship and fellowship. These qualities she had found wherever she had met, talked to or worked with members of the Guild, and she was sure that other members would find the same. Mrs. Glover, she continued, had worked very hard to keep the Guild in existence, and they must progress, as a token of their gratitude to her. Mrs. Jennings ended her address by thanking the local ladies, under the guidance of Mrs. Heather, for all that they had done to make the dance of the previous evening such a success.

The Annual Report

The hon. secretary then presented her report. At the beginning of the year she had been able, through the generosity of the B.V.A., to send copies of the minutes of the last A.G.M. to the Divisions. Many Divisions had worked very hard during the year, and among those mentioned were the Scottish, Lakeland, Welsh, Northern Ireland, Lincolnshire and South East Midlands.

At their meeting the Council of the V.V.B.F. expressed their warmest thanks to the Ladies' Guild for their contribution, which miraculously seemed to grow each year. As a mark of their appreciation, the Council had elected Mrs. Erica Thomson to fill the vacancy caused by the death of Mr. Arnold Spicer.

The hon. secretary wished to thank the retiring President, Mrs. Jennings, for all she had done during the past year. Despite many meetings to discuss Guild business and much correspondence her enthusiasm had never flagged.

The B.V.A. had been most generous, both in giving reprints and in allowing their headquarters to be used as a meeting place. Mr. Norman Male, the local committee, and ladies of the Congress social committee had made most of the arrangements for the meetings in Oxford, and for the dance on the previous evening, thereby relieving the hon. secretary of much responsibility. She wished to thank them all for the time and energy expended on the V.V.B.F. The Editor of THE VETERINARY RECORD had very kindly printed whatever was sent to him, which enabled members to keep in touch with the work of the Guild.

Treasurer's Report

A very high standard of hard work and enthusiasm had been set by Mrs. Glover, the hon. treasurer said, but the Divisional treasurers had been most helpful and in some cases had sent increased contributions. Some Divisions, although small, had obviously worked very hard to produce their contributions. The Scottish Divisions had sent £500 this year, which was about £140 more than the previous year. North and South Wales, too, were to be congratulated on nearly doubling their contributions, and she thanked the South Wales Division of the B.V.A. for their most generous donation. Northern Ireland had increased their contribution by almost £50, Lincolnshire by £100, and the South East Midlands by £70. The year-old Lakeland Division had sent £29 which was most encouraging for a new Division. She also wished to thank the Ladies' Committee of the B.S.A.V.A. for their generous donation of £150, a sum which was most sincerely appreciated.

The financial year ended on June 30th each year, and according to the rules she must receive all monies collected during the year by that date, so

she would be grateful if everyone would co-operate and send in subscriptions and donations well before then. The target for next year was to be £2,000; this year £1,882 3s. had been raised, an increase of £425 over the previous year. Details of the audited balance sheet are given below.

	£	s.	d.
Proceeds of Dance, Tombola, Cruise and Fashion Show at Glasgow	413	13	9
Central Division: Subscriptions and Donations	31	11	6
Eastern Counties Division: Subscriptions and Donations	15	18	0
Lakeland Division: Subscriptions and Donations	11	12	6
Lakeland Division: Cheese and Wine Party	17	10	0
Lancs. and Cheshire Division: Subscriptions and Donations	32	0	0
Lincolnshire Division: Subscriptions and Donations	22	2	6
Lincolnshire Division: Proceeds of Bran Tub —B.V.A. Dance	88	3	9
Midlands Division: Subscriptions and Donations	16	8	6
S.E. Midlands Division: Subscriptions and Donations and Dance	150	0	0
Northern Ireland Division: Subscriptions and Donations and other activities	150	0	0
North Wales Division: Subscriptions and Donations	16	15	4
North Wales Division: Proceeds of Dance ...	100	0	0
South Wales Division: Subscriptions and Donations	33	13	0
South Wales Division: Proceeds of Jumble Sale	26	7	0
South Wales Division: B.V.A. Collecting Boxes	11	4	6
Dance	25	19	8
Scottish Division: Subscriptions and Donations	117	6	10
Dance arranged by Mrs. Wilson at Ayr ...	94	0	0
Dance arranged by Mrs. Kennedy and Mrs. Fleming, Dumfries	96	18	8
Dance arranged by Mrs. Barr at Penrith ...	65	11	0
Dance arranged by Mrs. Anderson at Edinburgh	50	0	0
Dance arranged by Mrs. Service at Aberdeen	81	7	0
Honorary Treasurer: Subscriptions and Donations	63	19	6
B.S.A.V.A. Congress: Tombola and Anonymous Gift	150	0	0
	£1.882	3	0

The adoption of the hon. treasurer's report was proposed by Mrs. Glover, seconded by Mrs. Male and carried. It was resolved that £1.000 be allocated to the Current Relief Fund and £900 to the Special Gift Fund. This was proposed by Mrs. Thomson (Glasgow) and seconded by Mrs. Wooldridge.

Election of Officers

President, Mrs. Norman Male; *hon. treasurer*, Mrs. Erica Thomson; and *hon. secretary*, Mrs. H. I. Field.

Committee

The formation of the committee was discussed. In accordance with the rules this consists of the President, Vice-President, hon. secretary, hon. treasurer, all the chairmen of Divisions and three elected members. Mrs. Glover, Mrs. Heather and Mrs. Beynon were elected to serve.

Hon. Auditor

Mrs. Denham proposed that Dr. F. Bell be asked to act as hon. auditor for the current year and that Dr. Cochin be thanked for having acted as "locum" during Dr. Bell's absence.

Mrs. Male thanked the retiring Officers for their work during the past year. She said that her mother-in-law was one of the founder members of the Guild, so she had a double reason for being proud of the honour of being elected President. She hoped to form a new Division of the Guild within the Royal Counties Division of the B.V.A.

Copies of the Rules will be sent to all Divisions in due course.

VETERINARY PHOTOGRAPHERS AT THE B.V.A. CONGRESS

The President of the B.V.A. took the chair at a meeting on September 5th whose purpose was to consider whether a Veterinary Audio Visual Association should be formed. The President stressed the need for more vigorous efforts in this field, and concluded by paying tribute to the organisers responsible for putting on that afternoon's programme and mounting the photographic exhibition.

The first part of the programme was devoted to the projection of 14 series of colour slides, each series comprising approximately 6 slides. A descriptive commentary was given. Many of the slides were of considerable clinical interest as well as of superb technical quality. This part of the programme was concluded by showing 2 films.

The President then explained that the remainder of the time would be devoted to a business meeting. A very considerable number of interested persons remained, and a lively discussion ensued. The question of affiliation to the B.V.A. and the position of non-veterinarians in relation to the organisation was discussed.

The proposition "That a Veterinary Audio Visual Association be constituted" was put forward by Mr. P. R. Greenough and seconded by Mr. K. C. Barnett. The motion was carried.

"RESEARCH IN VETERINARY SCIENCE"

The attention of all our readers, is drawn to the currently published number of this scientific journal, which completes the second volume. It contains among a number of papers of high merit a most notable piece of research on scrapie by a United States scientist who had been working at Compton.

The journal has by now established itself in the international field, and has reflected very much credit on the B.V.A. as its originator and sponsor. Circulation has risen steadily, though many more subscriptions would be welcome. An advertisement containing the detailed contents of the October number, together with a subscription form, appears in the early pages of this week's RECORD.

News and Comment

ELECTION OF MEMBERS OF THE R.C.V.S. COUNCIL

In accordance with the provisions of the Veterinary Surgeons Act, 1948, 5 members of the Council, who must be members of the Royal College, will be elected in 1962 by members of the Royal College, residing outside the Republic of Ireland. Five present members of Council will retire at the Annual General Meeting in 1962 and are eligible for re-election, namely: A. J. Wright, Esq., J.P., M.R.C.V.S., Professor C. Formston, F.R.C.V.S.; J. F. D. Tutt, Esq., F.R.C.V.S.; Miss J. O. Joshua, F.R.C.V.S., G. C. Knight, Esq., F.R.C.V.S.

The term of office of the 5 persons elected in the place of the 5 members retiring by rotation will be 4 years.

Nominations of persons for election to the Council must be submitted in writing on a form which may be obtained from the Registrar, and which must be returned to him duly completed on or before January 31st, 1962.

Each nomination form must bear the signature of the proposer and seconder, who must not be present members of Council, and must be counter-signed by the nominee.

TRAVEL TO THE 12th WORLD POULTRY CONGRESS

We are asked to inform those readers who may be attending this congress that it is hoped to charter an air liner for the outward journey to Australia leaving London on August 3rd, 1962, and arriving in Sydney two days later. As seating is limited, those interested are asked to write immediately to the General Secretary of the B.V.A. Replies should be in his hands by October 31st, and if a sufficient number of bookings is made the charter will be finalised by the secretary of the United Kingdom national committee.

If all the seats on the charter aircraft are occupied, the individual fare for the journey London/Sydney will be about £160. For those who intend to return by the regular air service, the air fare (economy class) out and home would be: (a) *via* India, £408; (b) returning *via* North America (Round-the-World), £417. This provides a reduction of about £38 on normal fares.

For those who may wish for a more leisurely return by sea, there are three sailings of the P. & O.-Orient Line Steamers from Australia to the United Kingdom in September (calling at Naples and/or Marseilles), the fares for which are from £80 to £180 (tourist class).

THE BRITISH INSTITUTE OF RADIOLOGY

The first meeting intended directly to be of interest to veterinary surgeons has been organised by this Institute, and will be held at 32, Welbeck Street, London, W.1, on November 16th at 8 p.m. The programme will be as follows:—

Introduction, Gordon Knight, F.R.C.V.S.; "Radiography as an Aid to the Diagnosis of Lameness in Horses," J. J. Yeats; "Problems Relating to Radiography and Radiology of the Canine Thorax," R. G. Walker, M.A., M.R.C.V.S., and S. W. Douglas, M.A., M.R.C.V.S.; "Barium Meal Studies of the Alimentary Tract of Ruminants and the Pig," David Benzie, PH.D. All members of the profession will be most welcome at this inaugural joint meeting, at the end of which suggestions for further meetings and subjects of discussion will be invited.

PERSONAL

Mr. R. Scott Cameron has been appointed to the position of manager of the Veterinary Department of Parke, Davis & Company in succession to Mr. R. Jones Pugh. Mr. Scott Cameron was previously in general practice in Monmouth.

Births

LE RICHE.—On October 14th, 1961, at Mwanza, Tanganyika, to Dikka, wife of David Le Riche, M.R.C.V.S., B.V.M.S., D.T.V.M., a daughter.

LITTLE.—On October 7th, 1961, to Marian, wife of Roy Little, B.VET.MED., M.R.C.V.S., Virginia Cottage, Farley Hill, Reading, a daughter, Joanna Clare.

MACKAY.—On October 11th, 1961, at the Rubislaw Wing, Forolsterhill, Aberdeen, to Marian, wife of John W. Mackay, B.V.M.S., M.R.C.V.S., Beechlea, New Deer, a son.

SCAMBLER.—On October 3rd, 1961, to Barbara, wife of John D. Scambler, B.V.SC., M.R.C.V.S., of Ashfield, Inglewhite Road, Longridge, Lancs. A daughter, Margaret Ann, a sister for Peter and David.

WATERWORTH.—On October 13th, 1961, to Hazel (*née* Mears) and Jim Waterworth, B'S.V.SC., M'S.R.C.V.S., at 24, Norfolk Road, Carlisle, a son, James Stephen, a brother for Helen Deborah.

Marriage

REEVES — GILCHRIST. — At St. George's West Church, Edinburgh, on October 14th, Ronald Jonathan Charles Reeves, B.V.M.S., M.R.C.V.S., to Marion Paterson Gilchrist, M.A.

COMING EVENTS

October

30th (Mon.). EAST YORKSHIRE CLINICAL CLUB. Meeting at the Talbot Hotel, Malton, 8 p.m.

November

1st (Wed.). LINCOLNSHIRE AND DISTRICT DIVISION. Assistants' Meeting at the Eastgate Hotel, Lincoln, 7.15 p.m.

SOUTHERN COUNTIES VETERINARY SOCIETY. Meeting at the Royal Hotel, Winchester, 7.30 p.m.

2nd (Thurs.). R.A.V.C. DIVISION. Meeting at Bristol University Veterinary College.

CENTRAL VETERINARY SOCIETY. Meeting at the Royal Veterinary College, Camden Town, N.W.1, 6 p.m.

AYRSHIRE VETERINARY ASSOCIATION. Clinical Meeting in the New Building, Auchincruive, 7.30 p.m.

NORTH WILTS. VETERINARY CLUB. Meeting at the Goddard Arms Hotel, Swindon, 7.30 p.m.

3rd (Fri.). A.V.T. & R.W. SOUTHERN REGION. Meeting at the Royal Veterinary College, Royal College Street, Camden Town, N.W.1, 2.15 p.m.

4th (Sat.). B.S.A.V.A. SOUTHERN COUNTIES REGION. Meeting at Westcroft, Elm Lane, Earley, Reading, 7.30 p.m.

7th (Tues.). B.S.A.V.A. REGION 3. Meeting at Allen & Hanburys, Ware. Closing date for applications, November 1st.

8th (Wed.). CAMBRIDGE SOCIETY FOR THE STUDY OF COMPARATIVE MEDICINE. Annual Meeting in the Lecture Theatre of the Post-graduate Medical School, Addenbrooke's Hospital, Cambridge, 8 p.m.

9th (Thurs.). V.V.B.F. DUMFRIES AND GALLOWAY DIVISION. Annual Buffet Dance at the Cairndale Hotel, Dumfries.

B.S.A.V.A. SUSSEX REGION. Meeting at the New Imperial Hotel, First Avenue, Hove, 8 p.m.

10th (Fri.). R.V.C. COMMEMORATION BALL. To be held at the Royal Veterinary College, Camden Town, N.W.1, 8 p.m.

15th (Wed.). MIDLAND COUNTIES VETERINARY ASSOCIATION. Meeting in conjunction with the Warwickshire Veterinary Club at the Regent Hotel, Leamington Spa, 2.30 p.m.

15th, 16th and 17th (Wed., Thurs. and Fri.). B.V.A. Committee and Council Meetings in London.

16th (Thurs.). V.V.B.F. NORTHERN DIVISION. Annual Dinner Dance in the Northern Hotel, Aberdeen, 7.30 p.m.

BRITISH INSTITUTE OF RADIOLOGY. First Meeting at the British Institute of Radiology, 32, Welbeck Street, London, W.1, 8 p.m.

18th (Sat.). EQUINE VETERINARY SOCIETY. Inaugural Meeting at the Royal Veterinary College, Camden Town, N.W.1, 2.30 p.m.

18th and 19th (Sat. and Sun.). B.S.A.V.A. SOUTH WEST AND SOUTH WALES REGION. Clinical week-end at the Clifton Zoological Gardens, Bristol.

23rd (Thurs.). V.V.B.F. COUNTY OF AYR LADIES' GUILD. Annual Buffet Dance in the Western Hotel, Ayr, 8 p.m.

24th (Fri.). ASSOCIATION OF VETERINARY FOOD HYGIENISTS. Meeting at 7, Mansfield Street, Portland Place, London, W.1, 10 a.m.

December

6th (Wed.). A.V.T. & R.W. SCOTTISH GROUP. Meeting in the Assembly Hall at the University of Glasgow Veterinary Hospital, Bearsden Road, Bearsden, 2.30 p.m.

B.V.A. QUARTERLY COUNCIL AND COMMITTEE MEETINGS

Tuesday, November 14th

5 p.m. Finance Sub-committee.

Wednesday, November 15th

10 a.m. Small Animals Committee.
11.30 a.m. Parliamentary and Public Relations Committee.
2.15 p.m. Veterinary State Medicine Committee.
3.45 p.m. Home Appointments Committee.

Thursday, November 16th

10 a.m. Farm Livestock Committee.
2.15 p.m. General Purposes and Finance Committee.
(All the above will be held in 7, Mansfield Street.)

Friday, November 17th

10 a.m. Meeting of Council in the Connaught Rooms, Great Queen Street, London, W.C.
(p.m. Meeting of the Provisional Committee for the Scarborough Congress.)

ADDRESSES OF DISEASE INFECTED PREMISES

The list given below indicates, first the date on which disease has been confirmed, followed by the postal address and local authority.

Anthrax

October 19th, 1961. Mrs. A. J. Catchpole, Estate Office, Stowlangtoft, Bury St. Edmunds, Suffolk. Disease at: Kiln Farm, Stowlangtoft, Bury St. Edmunds, Suffolk (Parish: Stowlangtoft). (Cattle.) WEST SUFFOLK.

October 23rd, 1961. W. Freund, Wilcote House, Charlbury, Oxon (Parish: Finstock). (Cattle.) OXFORDSHIRE.

October 23rd, 1961. W. Gibson, Westerton of Stracathro, Brechin, Angus (Parish: Stracathro). (Cattle.) ANGUS.

October 23rd, 1961. W. Anderson, No. 9 Holding, Kaimhill, Bridge of Weir, Renfrewshire. Disease at: No. 10 Holding, Kaimhill, Bridge of Weir, Renfrewshire (Parish: Kilbarchen). (Cattle.) RENFREWSHIRE.

Fowl Pest

October 17th, 1961. H. J. Waters, Valley Farm, Bergh Apton, Norwich, Norfolk. NOR 38W. NORFOLK.

October 17th, 1961. Mrs. E. V. Fletcher, The Garage, Ickburgh, Thetford, Norfolk. Disease at: Ickcott, Ickburgh, Thetford, Norfolk. NORFOLK.

October 17th, 1961. L. J. Powell, Parkmore Farm, Torton, Hartlebury, Kidderminster, Worcs. WORCESTERSHIRE.

October 17th, 1961. G. H. Loveday, 60, Ragstone Road, Slough, Bucks. Disease at: East Burnham House, Burnham, Bucks. BUCKINGHAMSHIRE.

October 17th, 1961. Mrs. M. E. Tooth, Friars House, Morningthorpe, Norwich, Norfolk. NORFOLK.

October 17th, 1961. F. G. Ward, Moor Farm, Morningthorpe, Norwich, Norfolk. NORFOLK.

October 17th, 1961. H. W. Saich, Square Orchard, Breakspeare Road South, Harefield, Uxbridge, Middlesex. MIDDLESEX.

October 18th, 1961. H. W. & F. Greenacre, Thatched Cottage, Mundford, Thetford, Norfolk. NORFOLK.

October 18th, 1961. M. P. Clarey, Bleak House, Burgh Common, Burgh-le-Marsh, Skegness, Lincs. Disease at: Fen Lane, East Keal, Spilsby, Lincs. LINCOLN, PARTS OF LINDSEY.

October 18th, 1961. J. P. Wass, Lowna Farm, Kirbymoorside, York. YORK, NORTH RIDING.

October 18th, 1961. M. Szubert, 434, Farnham Road, Slough, Bucks. BUCKINGHAMSHIRE.

October 19th, 1961. Messrs. LeMay & LeMay, Fairlawn, Bulpham, Upminster, Essex. ESSEX.
October 19th, 1961. J. M. Abbott, Rookery Farm, Thuxton, Dereham, Norfolk. Disease at: Heath Farm, Thuxton, Dereham, Norfolk. NORFOLK.
October 21st, 1961. H. W. Gillings, Ickburgh Lodge, Mundford, Thetford, Norfolk. NORFOLK.
October 21st, 1961. Mrs. M. White, Longlands, Torton, Hartlebury, Kidderminster, Worcs. WORCESTERSHIRE.
October 22nd, 1961. J. W. Ramsey, Sydney House Stores, Nevendon Road, Wickford, Essex. ESSEX.
October 22nd, 1961. J. A. Cutting, The Gables, High Road, Fobbing, Stanford le Hope, Essex. ESSEX.
October 22nd, 1961. G. H. Bunby, 10, Rogers Lane, Stoke Poges, Slough, Bucks. BUCKINGHAMSHIRE.
October 23rd, 1961. R. G. D. Black, South Green Farm, Sibton, Saxmundham, Suffolk. EAST SUFFOLK.
October 23rd, 1961. J. P. Ketteringham, Brooklands Drayton, Norwich, Norfolk. NOR 52X. NORFOLK.
October 23rd, 1961. W. J. Grigg, Tylerset Farm, Dawes Heath Road, Thundersley, Essex. ESSEX.

Swine Fever

October 17th, 1961. W. J. Johnson, Rose Cottage, 10, Chapel Street, Badsey, Evesham, Worcs. Disease at: Bowers Hill, Badsey, Evesham, Worcs. WORCESTERSHIRE.
October 17th, 1961. G. H. Short, Hillside, Buckby Wharf, Rugby, Warwicks. Disease also at: George House, Buckby Wharf, Rugby, Warwicks. NORTHAMPTONSHIRE.
October 17th, 1961. C. Medworth, Bush Farm, West Newton, Hull, Yorks. YORK, EAST RIDING.
October 17th, 1961. W. J. Acreman (W. J. Acreman & Sons), Hill House Farm, Cambridge, Glos. GLOUCESTERSHIRE.
October 18th, 1961. F. J. Cripps, 163, Bedfont Lane, Feltham, Middx. Disease at: Allotments at rear of No. 3, Bedfont Lane, Feltham, Middx. MIDDLESEX.
October 18th, 1961. H. S. Powell, Moorend, Ashperton, Ledbury, Herefords. HEREFORDSHIRE.
October 18th, 1961. H. Hedgewald, Stephens Farm, Upper Stadmoreslow Lane, Harriseahead, Stoke-on-Trent, Staffs. STAFFORDSHIRE.
October 19th, 1961. W. Thomas, 7, Heal, Llangeinor, Bridgend, Glam. Disease at: Pig Cotes, Station Field, Llangeinor, Bridgend, Glam. GLAMORGAN.
October 19th, 1961. S. Storey (J. Storey & Sons Ltd.), Stella House Farm, Springwell, Gateshead, 9, Co. Durham. COUNTY DURHAM.
October 20th, 1961. G. E. & C. W. Stennett Ltd., Lux Farm, Playford, Ipswich, Suffolk. Disease at: Rance Park Farm, Harkstead, Ipswich, Suffolk. EAST SUFFOLK.
October 23rd, 1961. C. A. L. Evans, 6, Brick Houses, Milford Haven, Pembs. Disease at: Piggery, 65, Cellar Hill, Milford Haven, Pembs. PEMBROKESHIRE.
October 23rd, 1961. L. Wade, Spring Farm, Thurlby, Bourne, Lincs. LINCOLN, PARTS OF KESTEVEN.
October 23rd, 1961. W. A. Cornish, Horseheath Park Farm and Limberhurst Farm, Horseheath, Cambridge. CAMBRIDGESHIRE.
October 23rd, 1961. S. Morris, The Flights Farm, Ledbury, Herefordshire. HEREFORDSHIRE.
October 23rd, 1961. J. H. Davies, Newark Farm, Hempsted, Gloucester. GLOUCESTERSHIRE.
October 23rd, 1961. N. White, Red House Farm, Church Eaton, Stafford. STAFFORDSHIRE.
October 23rd, 1961. Mrs. W. C. Jubb, 23, Cranbourne Close, Hertford, Herts. Disease at: The Holding, Great Molewood, Hertford. HERTFORDSHIRE.
October 23rd, 1961. T. Mason, Rose Farm, Kirkham Road, Freckleton, Preston, Lancs. LANCASHIRE.

Letters to the Editor

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the B.V.A.

Downing's "Instructions"

Sir,—Mr. Sherwin Hall and your other correspondents on this most absorbing subject will, no doubt, be interested to learn that John Lawrence in the second volume of his "Philosophical and Practical Treatise on Horses" (1798) reviewed Joseph Downing's recently published work. Lawrence writes as follows:—

> "I have this instant before me a very small, but high priced book, to wit 130 thin pages, price half a guinea, under the name of Downing, a country cattle doctor of note; the author seems to set great store by his receipts, and in truth they are tolerably judicious; but at the same time such as an ordinary stock of medical knowledge must have suggested. The observations are few indeed, considered as the professed result of many years practice, and the description and appropriation of symptoms so vague and confused, as to afford little light; but the doctor deals in fine words, which will doubtless help to sell his book. Nevertheless I freely acknowledge the receipts and the *praxis* recommended, much superior to any ever published before in our language by a practitioner of that class, which is a pleasing evidence of their improvement; at the same time I am convinced there is many a journeyman apothecary, or mere tyro from the College, who, without ever previously having had a beast by the horns in his life, would in two years practice, produce a much more comprehensive and useful treatise."

It is strange that Lawrence does not refer particularly to the Appendix to Downing's book for this is good practical stuff as valuable to-day as it was when written. He chides Downing for the extravagant terms he employs and ridicules the extraordinary mixture he prescribes.

James White, in the Introduction to his fourth volume of "A Treatise on Veterinary Medicine" (2nd edition, 1818), dealing with books on cattle medicine says that the greater part of them appear to have been manufactured in London by persons totally unacquainted with the subject.

Reviewing those which seemed to him to have been written by the persons whose names are affixed to them he mentions the "Practical Treatise" by Edward Skerrett (sic), "Every Man his Own Cattle Doctor" by Francis Clater and "A Treatise on the Diseases of Horned Cattle" by Joseph Downing.

About Skellett's work, White says that a great deal of the "theoretical, anatomical and physiological matter in the first part appears to have been taken from the writings of medical men, and is of course wholly unintelligible to those persons for whom this book, we suppose, was intended." He gives Skellett credit for judicious directions for extracting the calf in difficult

labours but with respect to the remainder of the work, which treats of diseases, he simply transcribes one recipe with the comment, "I think this is a sufficient dose to destroy the strongest animal."

Of Clater's book, White contents himself with saying that, in many of the receipts, the ingredients are so numerous and expensive that should there be occasion to continue their use for several days, they would, he feared, in many instances, exceed the value of the unfortunate animal which might be obliged to swallow them. Clater described himself as a chemist and druggist.

White extracts from Downing's book a number of receipts, describes them as curious and recommended with eloquence, and concludes with the remark, "So much for Mr. Joseph Downing."

Interestingly enough White, like Lawrence, fails to mention Downing's Appendix.

My reason for drawing attention to these comments and criticisms is that they are taken from writers contemporary with Downing and Skellett. Although Sir Frederick Smith states that Downing's work on the diseases of cattle was an unblushing literary theft from Topham and his obstetrical operations were purloined by Skellett, neither Lawrence nor White gives any hint of plagiarism of this sort.

Smith was particularly adept at detecting literary theft but I believe that on occasions he allowed his enthusiasm for exposure to mislead him. Close examination of the obstetrical descriptions of Downing and Skellett leads me to the belief that here were two acute observers working in the same field and coming to the same conclusions—one a practical countryman and the other a well-educated scientific worker.

Smith records that Skellett writes in his preface, "the rules of obstetrical practice are not known to any author," but the actual words employed by Skellett are, "he has introduced rules of practice unknown to any other author who has published on this part of the business." It is by no means certain that Skellett was doing Downing an injustice. The fact remains that these two obstetrical treatises are classics and can be read to-day with advantage.

Yours faithfully,

Roughwood House, J. W. BARBER-LOMAX.
Chalfont Lane,
Chorleywood,
Herts.

October 23rd, 1961.

Appeal for Ciinical Material

Sir,—Recent research in Edinburgh into the treatment of osteogenic tumours has given results which we regard as very promising.

May we, through the courtesy of your columns, appeal to all members of the profession for material which we require very urgently.

We would be very grateful if anyone could refer to us any cases of dogs suffering from osteosarcoma. Treatment and travelling costs would be free if required.

The prognosis for animals sent to us would, necessarily, depend on the condition of the individuals concerned but, in cases where treatment is possible, we believe we can offer rather better than the hopeless outlook which such cases face at present.

Finally, we would like to stress the obvious implications of this work which we hope may yield benefits in both the medical and the veterinary worlds.

Yours faithfully,

J. G. WATT.
Royal (Dick) School of Veterinary Studies,
Summerhall,
Edinburgh, 9.

October 17th, 1961.

"Factors Influencing the Properties of Boar Semen"

Sir,—In the paper entitled "Factors Influencing the Properties of Boar Semen," published in THE VETERINARY RECORD of August 19th last, I made four regrettable omissions from the list of references. As a consequence there was a factual error in the first paragraph. I said that ". . . with the exception of Wallace (1948) little interest was displayed in these aspects of the reproductive physiology of the boar until Aamdal and Hogset (1957) . . ." Anyone familiar with the subject will know that this is incorrect since the notable contributions of Glover, and Glover and Mann were published in 1954 and 1955.

May I take this opportunity of apologising to the authors concerned and of asking you to print the references which I omitted?

GLOVER, T., & MANN, T. (1954). *J. Agric. Sci.* **44.** 355.
GLOVER, T. D. (1955). *Vet. Rec.* **67.** 36.
———. (1956). Ph.D. Thesis, University of Cambridge.
MANN, T., & GLOVER, T. (1954). *J. Endocrin.* **10.** IV.

Yours faithfully,

P. RADFORD.
University of Bristol,
Department of Animal Husbandry,
Langford House,
Langford,
Bristol.

October 23rd, 1961.

Diseases of Cage and Wild Birds

Sir,—I am carrying out a survey on the disease of cage and wild birds, excluding poultry, and would be willing to examine and report on any carcases received from veterinary surgeons.

If any members wish to take advantage of this service, I would be able to supply case history sheets, small containers and addressed labels.

As this service is part of a research project there will be no charge.

Yours faithfully,

Petfoods Ltd., DAVID K. BLACKMORE.
Melton Mowbray,
Leicestershire.

October 19th, 1961.

Atony of the Rumen

Sir,—The time when one gets most cases of atony of the rumen is approaching, and I wish to draw attention to a compound* I have been trying out for

* Rumenal, supplied by Laboratory for Applied Biology.

over 2 years. Evaluation of drugs in the field is not easy. When it is not possible to have untreated controls, the numbers of treated cases must be large.

The compound contains the active principles of Veratrum. One dose is given per day for 1, 2 or 3 days. Care must be taken in diagnosis as the compound acts very powerfully on the rumen musculature. It is contra-indicated in traumatic reticulitis and displacement of the abomasum. In a series of 183 cases treated and recorded, 112 responded satisfactorily to 1 dose, 58 needed a second dose, 4 cases turned out to be traumatic reticulitis where blood samples had not been thought necessary for differential diagnosis, and 9 cases did not respond satisfactorily for reasons some known, and some unknown. The usual treatments containing nux vomica or ammonium carbonate have been found no better than leaving the animal untreated; but in my experience this new compound is an improvement and does work satisfactorily in atony of the rumen which, though not a serious condition, yet is fairly common and causes loss and worry to farmers.

I hope soon to publish results in more detail.

Yours faithfully,
Wm. J. JORDAN.

Green Paddocks,
Pulford,
Near Chester.
October 21st, 1961.

The Future of the Profession

Sir,—I was very interested to read Mr. Welch's letter in THE VETERINARY RECORD of October 21st and think that some control of the use of funds donated to charities could go a long way towards settling our difficulties with the animal welfare societies, and also towards making them carry out their original and necessary purpose.

Recently, and without any consultation with local practitioners, one of the three clinics of a local society had to be moved because of redevelopment in this city. Considering the extent of this vast conurbation of over 1,000,000 people, it was remarkable that the site chosen for the new clinic was one which is almost inaccessible to all but a handful of the poor and needy. One can only assume that the prominent siting of this clinic in a high-class residential area was an open attempt to attract a clientele other than those in need of financial assistance. A letter of protest to the society's secretary in London confirmed this, since no attempt was made to defend the site as a good centre for charitable work among the poor.

However, as suggested by Mr. Welch, I had recourse to one of the guardians of democratic institutions, my local Member of Parliament, and pointed out to her that here was a probable case, not only of misuse of charitable funds, but also one that made nonsense of the concessions made to the society by the Ministry of Agriculture and the income tax authorities. No interest was shown except, after reference to the Ministry of Agriculture, to point out just what jurisdiction they had over the society in question.

If I had not had a slight interest in the matter I would have submitted a letter about it to that other guardian of democratic institutions, the correspondence columns of *The Times* and I have no doubt that a letter sent there by a more erudite pen than mine might provoke an interesting correspondence.

Yours faithfully,
J. L. R. LEACH.

371, Hagley Road,
Edgbaston,
Birmingham, 17.
October 23rd, 1961.

Sir,—Regarding my letter published in your issue of the 14th inst. I would like to remark on the editorial comment. I am perfectly well acquainted with the information supplied in the "Guide to Professional Conduct." What I wanted was a much more specific answer to the points raised by Mr. Harold L. Smith and myself.

We all know, or should know, that unqualified assistance may be employed by a registered veterinary surgeon or practitioner. I have never had the need to employ such help myself, but if the occasion arose I should certainly make quite certain that there would be no publicity for the unqualified "aid." In fact under no circumstances would I employ any person who advertises his services, as, for instance, many "physiotherapists" do. I cannot understand in what circumstances press notes refer to unqualified people without mentioning that such people are acting under a veterinary surgeon's instructions and supervision. If such unauthorised and unqualified practice does take place, surely it is the duty of every veterinary surgeon to report the matter, and that the R.C.V.S. take the matter up, at law if necessary.

Regarding the animal welfare organisations. Surely it is the law and the intention of the law that such organisations are only allowed to function on condition that they treat only the animals of owners who genuinely cannot afford private veterinary fees? If this is not the case it could well mean that an animal welfare organisation could take every advantage in publicity (which they make full use of as "charities") and then carry out private, remunerated work, for their wealthy clients in hospitals or otherwise. This would, in effect, mean that if they employed a qualified veterinarian to carry out such treatment he would be allowing advertising, or touting, indirectly on his behalf.

Surely someone can produce an authoritative statement on these matters which is not simply excerpts from what every veterinary practitioner should know? Is it too much to hope that we may be given some constructive comments on the correspondence?

Yours faithfully,
MILLER WATSON.

11, Annfield Place,
Glasgow, E.1.
October 16th, 1961.